CASSELL'S PEOPLE'S PHYSICIAN

A BOOK OF MEDICINE AND OF HEALTH FOR EVERYBODY

IN FIVE VOLUMES

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A Book of Medicine and of Health
for Everybody

Illustrated with Coloured and Black-and-White Plates
and with Figures in the Text

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CHAPTER LXXIV

DEFINITIONS

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HEALTH is the best of all material blessings, and perhaps the most intimate and aggressive of all ideas. The Englishman's first inquiry is, "How do you do?" the Frenchman's, "How do you carry yourself?" the German's, "How do you find yourself?" and all over the globe salutations of a similar character prevail. Is not the very word "salutation" derived from *salus*, health? What is "hail" but "heal"? What is "vale" but "be strong"? We cannot even drink our wine without proposing somebody's health.

And yet, like all popular ideas, the idea of health has been vaguely and variously conceived, and is difficult to define. How are we to define it?

Health originally meant wholeness, and on wholeness of structure healthy function must depend; yet any satisfactory definition of health must lay stress, not on structure, but on energy. Health is essentially energy; energy is the most typical manifestation of health. The most obvious sign of failing health is usually habitual lack of energy; the most obvious sign of vigorous health is usually abundance of energy.

We might define health, therefore. as that condition of structure

and function which results in the production of most energy, potential or actual. But this definition must be further defined, for all energy is not of the same character; there is an energy that is healthy and an energy that is morbid. A madman has often terrific energy, yet the energy is certainly not a manifestation of health. Even a dying or diseased man sometimes shows wonderful energy. How are we to denote this distinction with a difference?

Health Defined.

In order to get at the root of the matter we must look for a moment at some of the characteristics of living energy. Energy, we find, cannot be produced from nothing—*ex nihilo nihil fit.* It always requires an expenditure of living tissue. We cannot wink an eyelid, or move a finger, or think a thought, without loss of living substance; and during the Oxford and Cambridge boat-race the oarsmen lose pounds of weight in a few minutes. It is obvious, therefore, that if there were no means of repairing loss, the result of energy must be physical bankruptcy.

Vital Energy.

A man can hardly be considered financially sound who is drawing money from a bank without paying money in again; whereas, if he draws money from the bank in order to make more money, or if he deposits as much as he withdraws, his bank account may be considered healthy. Now the energy of health must be considered as only energy of such a nature, and such a degree, that income and expenditure more or less balance; and health may be further finally defined as that condition of structure and function in a living organism which results in a maximum of useful energy with a minimum of waste, and with the most complete recuperation. The energy of health not only breaks down but also builds up again, and is therefore self-sustaining. Health, in brief, is that condition of structure and function in any organism which results in the most efficient and self-sustaining energy.

Let us take some concrete examples to illustrate our definition.

Take, for instance, the case of the aforesaid madman, whose feats of strength are prodigious. His energy is immense, but it is wasteful; it results in the long run in an emaciated body, and in a diminution or curtailment of energy.

Or take the case of a man with a heart that leaks. It is obvious that, as in the case of a leaking pump, much of the work of the heart is lost and inefficient. The result is that that portion of the total energy

which should go to repair the waste is deficient. In a word, there is inefficiency in expenditure, and deficiency in income.

Or take the case of a man who habitually over-eats. He is producing plenty of energy, but he is using it unwisely, unhealthily, inefficiently, since the energy results, not in good material, which will again produce energy, but in fat, which will be, in many instances, worse than useless. The man is, in fact, withdrawing good money and paying in counterfeit coins, or at least worthless cheques, which the Bank of Life will dishonour. Further, he is using an undue amount of his whole constitutional energy (which is limited in amount) for *party* purposes.

Even when a man in health voluntarily performs an amount of work which results in impaired vigour, he must be considered, for the time at least, unhealthy ; and if he persists in overwork, he may end by becoming a chronic invalid.

It may be objected, with reference to the definition of health suggested, that perpetual motion is not possible, that all living is dying, that all work involves waste, and that in old age waste always exceeds repair ; and this objection is not without force. Still, for all practical purposes, expenditure of energy with recuperation and conservation of energy must be considered the ideal of health.

When we define health as energy, thus used to the best advantage, and thus conserved, we must, of course, recognise that the energy must vary *in kind* with the organism, for the first function of energy is adaptation to environment. A limpet is most healthily energetic when it clings to a rock ; a man, when he makes the rock into a city. The baby that merely sucks and sleeps is as healthy as the man who walks 1,000 miles in 1,000 hours, or who writes 10,000 words a day.

Health not a Fixed Quantity.

It will be noticed that there is no fixed quantitative standard of health. The greatest degree of health of which any organism is capable is the greatest degree of energy of which it is capable, without permanent diminution of its potential energy ; and this greatest degree of energy will vary within wide limits, in different organisms, under different conditions. However we define health, we must always have a definition elastic enough to include varying degrees of health—of potential energy. The larger the expenditure possible without bankruptcy, the higher will be the degree of health, and the more efficient the organism ; but even where only a small

expenditure is possible, the individual may be quite healthy, provided the small expenditure is not necessitated by disease, and provided the internal and external environment require only such small expenditure. Thus a man leading a sedentary life will expend less muscular, respiratory, circulatory, and digestive energy than a manual labourer, and may be capable of only small expenditure, and yet his health may be good. Indeed, we may paradoxically say that sometimes the less the energy the greater the health. If, for example, a big, burly, country labourer, with great muscular and respiratory energy, and with sound organs, tries to live in the slums, on bad air and poor food, his accounts will not balance; the sword will wear out the sheath, and he will probably become ill and die; whereas the little, wiry man with puny muscles and contracted chest will get enough air and food to pay his physiological debt, and so will live. The big man may have the greater potential health, but in an unsuitable environment his energy means bankruptcy.

How Disease Makes for Health.

In looking at health in its larger, national aspects, we meet with a second paradox—namely, that disease makes for health. Disease is a process that eliminates the unfit, and adapts organisms to their environment. So we find nations that have been long subject to malaria, healthier in a malarious environment than those who have never even seen a mosquito; we find those that have been decimated by consumption show more resistance to the tubercle bacillus than those that have had no experience of it in the past; and we find those that have long been exposed to the ravages of alcoholism more sober than those that have never beheld a whisky bottle.

Ill-health.

Ill-health is generally due either (*a*) to some inborn structural defect —e.g. a child may be born with a defective heart, resulting in defective or ill-directed energy; or (*b*) to some acquired defect—e.g. a man may rupture his liver, or inhale microbes to the hindrance or waste of his energy; or (*c*) to some functional defect, some overstrong or overweak action of a part without any obvious structural injury—e.g. diarrhœa or constipation.

Whatever the nature of the ill-health, it always results in impaired efficiency of energy, as shown in both its constitutional and external manifestations. If a sick man's pulse be felt it will be found to be too fast or too slow, too strong or too feeble; if his respirations be counted, they will likewise be found not to be in accordance with the require-

ments of efficiency; if his temperature be taken, it will be found to be unduly high or low. In time the sick man becomes weak and anæmic, and his walk, his talk, and others of his actions will evince impairment of energy.

In some cases, a man of strong will (so-called) will continue to exercise his higher energies; he will speak, act, think energetically even while his organic functions—the working of his heart, of his lungs, of his digestion, etc.—are impaired; but still, if the general trend of production of energy is downward, he cannot be considered a man in good health, and his volitional activity will only hasten his physical bankruptcy. It may be stated as a law of health that the pace of life must be regulated by the weakest organ—that a weak heart or weak digestion must necessarily retard all the other vital activities.

Mind and Body.

The energy of the mind, which is the greatest of all energies, seems sometimes to stand by itself, and to be to a great extent independent of the other energies. Even a dying man may be able to think clearly, and strongly, till the end; and there are well-authenticated instances where dying scientists have counted their own pulse-beats almost to the final beat. Many delicate and unhealthy men, too, have done powerful intellectual work—e.g. Pope, Keats, Heine, Johnson, Herbert Spencer, Robert Louis Stevenson, and Finsen. Granted, however, this apparent possible independence, yet the fact remains that in most cases the mind clearly shares the general health, and weakens as the other energies weaken, and especially as waste exceeds repair.

Certainly the *emotional* quality of brain-work is affected by general health. There is a French saying: "*Bonne ou mauvaise santé fait notre philosophie*" (Good or bad health makes our philosophy), and there can be no doubt at all that a man's philosophy of life is affected by his health. A man may think as vigorously before dinner, but "a hungry man is an angry man," and after dinner he has more energy to untie his purse-string. Dr. King Chambers, in his "Manual of Diet in Health and Disease," remarks: "Deficient diet, like all other morbid conditions, both corporeal and mental, is a vitiating and degenerating influence. Famine is naturally the mother of crimes and vices, not only of such sort as will satiate the gnawing desire for food, but of general violence and lawlessness, ill-temper, avarice, lust, and cruelty." "A hungry belly lacks ears," said Cato the Elder. Alterations in secretory

energy and reflex nervous action are especially potent in altering emotional tone; and this fact is recorded in many popular expressions. We talk of "spleen," of a "white-livered" poltroon, of "jaundiced" views, of "eupeptic" optimism, and so forth. It is well known, too, that overgrowth of the gland in the neck, known as the *thyroid*, is followed by marked changes in temperament, and that the martial character of the Amazonian women was largely due to removal of their left breasts.

Mind and body must, therefore, be considered as working in unison, and the ideal to be aimed at is *mens sana in corpore sano*—an energetic mind in an energetic body.

The Pace of Life.

At this point an interesting question presents itself. Many energies are more or less completely under the dominion of the will, and these energies a man is able to spend as quickly or as slowly as he will. A man, in these respects, may live a fast life or a slow life. In America, where the so-called *strenuous* life is fashionable, men are often "too old at forty"; they have used up most of their recuperative powers, and have little energy left to spend. Now the question is, Ought a man to concentrate his energy into the first forty years of his life, to the consequent impoverishment of after years? He can do so, and still be healthy, provided that in later years he goes very slowly. He *can*, but *should* he?

It may be said that—

> "One crowded hour of glorious life
> Is worth an age without a name,"

and that moments may be big as years. It may be argued that—

> "We live in deeds, not years; in thoughts, not breaths;
> In feelings, not in figures on a dial.
> We should count time by heart-throbs."

That is true. But

> "He most lives
> Who thinks most, feels the noblest, acts the best."

And the man who concentrates the bulk of seventy years' energy into the first forty neither thinks most, feels the noblest, nor acts the best. He is living at a higher pressure than is compatible with full efficiency, and he is never able to behold life in its true perspective. Life has its

seasons—infancy, youth, maturity, old age—and each has its own energies and experiences. Browning makes Rabbi Ben Ezra cry :—

> "Grow old along with me,
> The best is yet to be,
> The last of life,
> For which the first was planned."

But the man too old at forty must regard old age as a sterile, dull, unprofitable season. Mortgage is always costly, and he who mortgages his future must pay heavy interest. Doubtless, many are compelled to overwork, and doubtless many more overwork unwillingly; but every man anxious to make the most of life should aim at apportioning energy judiciously, and using it so as to attain, so far as possible, a maximum return for expenditure.

Health usually both implies longevity and conduces to longevity, and anyone born with sound organs, and furnished with average energy ought—barring accidents—to live to a good old age. How long a healthy man ought to live, is a question open to debate. According to the popular notion, he ought to live to the age of seventy; but according to the great Russian scientist, Metchnikoff, he ought to live about 140 years.

Longevity.

Whatever estimate of normal healthy longevity be taken, the waste of potential energy, as shown by the present death-rate, must be tremendous, for most of us start with sufficient store of energy to carry us, if it be well regulated, through a long life, and early death is due either to misdirected energy or to accidental damage to one of the wheels of life; only very rarely do men live till their total store of energy is exhausted by normal and necessary energising. In most instances something happens to increase the resistance against which the energies of the organism must work. In overcoming this resistance energy is wasted, and the various functions become inco-ordinate, and the machine of life prematurely stops.

Waste of Energy.

Take the case of pneumonia, which kills so many people in middle life. A germ gets into the lungs and causes a disturbance and misdirection of energy, which results in more or less consolidation of the lungs. The heart, which has to pump blood through the lungs, has thus extra work to do, and becomes exhausted and may stop. This is death by overwork of one organ, with inadequate recuperation. Death

is usually due to such failure of one part. The organism does not fall to pieces all at once like the deacon's "wonderful one-hoss shay"—it breaks down owing to the accidental overwork of one particular part.

We have said that health affects a man's temperament; and health is of great concern to most people, largely because of its subjective effects, because of the sense of *bien-être* it produces. A healthy man is a happy man, and a happy man, moreover, is more healthy because of his happiness. Not only so, but the healthy man is usually the good man; health and holiness are derived in more than one sense from the same root. Health, therefore, has its spiritual as well as its physical side. Indeed, the importance of health both to the individual and to the community at large can hardly be over-estimated. The world is made and moulded by man for his own purposes, by his own vital energy, and the greater the energy the greater and more noble the result. It is the health of the Anglo-Saxon that has made England a mighty imperial nation. Only the healthy can be pioneers, hewing their ways through virgin forests, making wheat-fields out of prairie lands. The unhealthy lack courage, energy, initiative, and must break down under strain.

Health in War.

In war, health is a weapon of paramount importance, quite as valuable as long-range artillery. Napoleon used to say that he won campaigns by the legs of his soldiers, and many a battle has been lost through lack of health. In the recent Russo-Japanese war, superior health did much to win battles for the Japanese; and probably they saved as many soldiers by their health measures as by their strategy.

Vulnerability of Health.

It must be noticed, however, that health is never invulnerable. There are diseases against which health, as we have defined it, is powerless. The tubercle bacillus, which causes the disease consumption, is no respecter of the healthy, and the strongest men may fall victims to its virulence. The germ of pneumonia seems almost to have a preference for the robust. A new disease may exterminate a whole nation. A disease called the sleeping sickness, due to a germ sucked from the blood of crocodiles by flies, which communicate it to man, is killing hundreds of thousands of healthy savages; and whole tribes of Red Indians, a healthy, energetic, long-lived people, have been slain by small-pox.

Still, even against germs, the vigorous action of the bodily organs is in some measure a protection, and in many cases recovery from germ

diseases is largely a question of constitutional energy. The modern sanatorium treatment of consumption tries to cure or arrest the disease simply by improving the general health.

The foundations of health may reach back for generations; the sour grapes of the parents may set on edge the teeth of the children; but even in cases of evil heredity a great deal can be done to establish health if measures be taken in childhood to bring up children in the paths of "physiological righteousness." Nothing is at present more required in this country than open-air schools, where delicate town-born children may be taught, not so much how to read and write, as how to live healthy lives. The present influx from country to town does not make for health, for it is a well-known fact that the death-rate is lower in rural districts than in towns, and any educational influence which will counteract the city-craving and city-degeneration is much to be welcomed.

Public Health.

A man's health is as important as a man's morals to the community; no man is healthy or unhealthy to himself alone; and there is a department of medicine, known as Public Health—to be dealt with in a later chapter—which deals with the general health of the community, and endeavours, chiefly by preventive measures, to lower the death-rate, and to raise the general average of health. Measures are taken to improve the environment of the community by controlling infectious diseases, by bettering sanitary conditions, by providing good food and water, by regulating trades; and quite recently medical inspectors have been appointed to look after the health of children in our elementary schools.

The Mind Greater than the Body.

The health of a nation is the measure of its greatness; but it must never be forgotten that energy of mind is greater than energy of body, and that energy of body without energy of mind is simply a ship without a rudder. The Japanese are a great and growing nation because they combine in a wonderful way health of mind and health of body, and if England is to retain her place as a great Imperial Power she must see to it that she breeds and cultivates the greatest of all energies—Energy of Mind.

CHAPTER LXXV

THE LAWS OF HYGIENE

The Great Vital Energies—Digestive Energy : A Multiplex Mechanism—Age and Diet—Work and Diet—Climate and Diet—The Personal Equation—Over-eating — Under-eating — Constipation — Digestive Ferments. Respiratory Energy : Air and Spirit—Mechanism of Respiration—Meaning of Breathing —Foul Air—Pure Air. The Circulation Energy : Deficient Heart Energy —How the Heart can be Strengthened. Nerve Energy : Its Dependence on the Other Energies. Circumstances affecting Health : Sleep—Sunlight—Exercise—Cleanliness — Clothing — Habitation — Stimulants — The Mental Factor in Health—Worry—Happiness.

HEALTH, as we have explained, is in its essence *energy*—energy of mind and energy of body ; and all measures taken to preserve or increase energy may be called hygienic measures.

The three great vital energies on which all others depend are nerves, blood, and breath. Oliver Wendell Holmes puts it thus : "There are three-wicks, you know, to the lamp of a man's life : brain, blood, and breath. Press the brain a little, its light goes out, followed by both the others ; stop the heart a little, and out go all three of the wicks. Choke the air out of the lungs, and presently the fluid ceases to supply the centres of flame, and all is soon stagnation, cold, and darkness."

The Great Vital Energies.

These are three great energies, but they depend for their continuance on a fourth energy—the energy of digestion. Starve a man and his heart flags, his brain weakens, his breathing falters. The digestion is the *causa causans* of all the other energies ; indeed, regarded in its widest sense, it is the energy which makes an ovum into a man.

In considering, then, the laws of hygiene, as a preliminary to a more detailed treatment of the subject of Health, we must consider these four great energies ; and we will consider first the digestive energy.

It is a commonplace that the digestion is apt to get out of order. One has only to regard the popularity of patent pills and potions to

realise the prevalence of digestive disorders. It is a startling fact! Here is a great, necessary, organic energy, and apparently it is always out of sorts. What efficiency can be expected in a motor engine, when the carburetter which supplies the explosive is always going wrong? How are we to account for this tendency to derangement? Is the engine of life radically weak, or do we abuse it, or is our petrol bad? The digestion may be weak, but its disorders are usually due to unskilful driving. We drive it too hard, we give it too little air, or we provide bad petrol.

Digestive Energy.

The mechanism, as has been shown elsewhere in this work, is multiplex. The mouth, the stomach, the bowels, the liver, the pancreas, are all concerned in the task of digestion, and any failure of one part may mean failure of all. If the teeth are bad or insufficiently used; if food is taken that will congest the liver, or inflame the stomach, or constipate the bowels, the whole process of digestion may be hampered and hindered, and all the other bodily energies will be starved and stunted.

A Multiplex Mechanism.

And yet, despite the complexity of the mechanism, the laws of good digestion are quite simple, and may be tabulated as follow:—

1. The food must be suitable in quantity and quality.
2. The food must be well masticated.
3. Meals must be regular, and must not be taken immediately after, nor immediately before, exercise.
4. There must be plenty of fresh air.

If these general rules are kept, the stomach, the liver, the pancreas, and the bowels will all act as they should.

This is not the place to discuss these rules in detail, but it must be recognised that the non-observance of the latter two rules is quite commonly the cause of indigestion, and that, without their observance, special dietaries will be tried in vain.

It must be remembered, too, that diet must vary with the age of the individual. Hippocrates, the old Greek physician, remarks: "Old men bear want of food best; then those that are adult; youths bear it least, most especially children, and of them the most lively are the least capable of enduring it." Milk alone is sufficient for an infant; the varied activities of adolescent and adult life require a diet richer in energy-producing material; while in old age, again, a simple and meagre diet is best.

Age and Diet.

The activity of the individual must also be considered. A working navvy will require more food than a clerk or a seamstress. American brickmakers, it is stated, eat five or six times as much as Japanese students.

Work and Diet.

Climate, too, must be taken into account. A good deal of the food consumed goes simply to keep up the bodily temperature, and in a hot climate much less food is required for this purpose, and a heavy diet leads almost inevitably to ill-health. An American scientist, Professor Chittenden, of Yale, has recently been making experiments upon various classes of men, and has shown that health is improved—*i.e.* energy and power of work increased—on a diet containing not much more than half the amount of proteid food ordinarily consumed; and there can be little doubt that too much food is eaten by most people, and that a reduction in diet would in most cases be followed by an improvement in health.

Climate and Diet.

In determining the amount of food best for each man, however, it is impossible to proceed entirely on general principles. The *turn-over*, so to speak, of man and man varies tremendously; and, apart altogether from questions of activity and climate and age, individual idiosyncrasies require consideration. An Italian named Cornaro lived for fifty-eight years on 12 oz. of solid food and 14 oz. of light wine a day; and, on the other hand, Esquimaux eat (according to Sir John Ross) about 20 lb. of flesh a day; and Captain Cochrane relates, in his "Journey Through Russia and Siberian Tartary," that he saw three Yakutis devour a reindeer at one meal.

The Personal Equation.

The most obvious result of over-eating is to form fat, which hampers the action of the heart and other organs, and to divert more energy to the process of digestion than the other functions can spare. The over-eater wastes energy, and, though his rotund and robust appearance may give him the semblance of rude health, he is never really a healthy man. Over-eating is especially pernicious in the case of those who live sedentary lives, and in such cases gout and fatty heart may result. Not far wrong is the saying which warns people that they may dig their own graves with their teeth. The Latin proverb to the effect that the knife and fork kill more than the sword gives us the same truth in another form.

Result of Over-eating.

Taken as a nation, the Japanese are about the healthiest nation in the world, and they are also very small eaters; and it is often found that small eaters are *gluttons for work.* Complete fasting is sometimes good for the health, and even those who do not habitually over-eat would be none the worse for complete abstinence for twenty-four hours two or three times every year. Fasting rests at once the organs of digestion and those of excretion, and is a therapeutic expedient too much neglected.

Dangers of Under-eating.

In some cases, however, lack of general energy—and, indeed, lack of digestive energy—is due to under-eating. Many sufferers from indigestion deny themselves this food and that food, and after a time there is almost nothing left that they can eat, and the result is not only emaciated muscles, but also a weakened nervous system and deficient digestive energy.

In consumption, under-feeding is particularly dangerous.

Constipation.

One of the commonest causes of digestive ill-health is, of course, constipation; and constipation, again, is due to errors in diet, to indulgence in pills, or to deficient nerve power. Those whose dietary is bland and soft, with little residue, are especially prone to constipation, and in such cases an increase in the amount of fluid ingested, or a change to diet such as porridge or brown bread, will be markedly beneficial. Fruit, such as figs, dates, pears, apples, is also efficacious in constipation. Pills and drugs should be avoided as much as possible, for they ruin the natural sensitiveness of the bowels, and create a dependence on artificial stimulus, which is wholly unhealthy. In scarcely any cases are drugs necessary, and frequently a tendency to constipation can be cured by the very simple expedient of regular and punctual attention to the calls of nature. The man or woman who is irregular in habits, and who neglects the calls of nature, soon kills the conscience of his organs, and suffers accordingly, and many cases of anæmia in women are due simply to habitual neglect.

Constipation, through the retention of waste products, causes absorption of poison, and results in sallow complexion, headache, listlessness, irritability, and general ill-health.

This is the age of digestive adjuvants and digestive fads. One man predigests all his food with the digestive ferments of a pig; another man can eat nothing but mincemeat. In most cases, the trouble is chiefly hypochondriacism—a trouble less fatal than the ugly name

sounds. Nature is not so foolish as to give a man an organ that requires such unnatural and eccentric assistance; and in nine cases out of ten the pampered and fastidious digestion will be found quite capable of digesting ordinary simple food, if only the pseudo-dyspeptic will live in other respects a healthy and natural life. "Little Mary" is not "too pure and good for human nature's daily food."

Digestive Ferments.

For most digestive disorders, indeed, there is very little excuse, and in most cases observance of the few simple rules we have stated will be followed by digestive efficiency.

Respiratory Energy.

Day and night, from the cradle to the grave, the ribs rise and fall; the great muscle called the diaphragm, that separates the chest cavity from the abdominal cavity, slackens and tightens; day and night, from the cradle to the grave, the great bellows of the chest draws in and drives out the breath of life. Let it stop for a few moments, and the man dies.

Air and Spirit.

Even primitive man was impressed by this strange phenomenon and its close relation to life; and we find in the language of early peoples that breath and soul are synonyms. Something entered the body and gave it life; God, as the Hebrew poet put it, breathed into man's nostrils the breath of life, and he became a living soul. Something issued from it—the soul took flight—and the man died. As late as the seventeenth century it was commonly held that breath was the source of the spirit—or, rather, that the vital spirit was compounded of blood and breath; and only when Harvey demonstrated that the blood-vessels contained no air was the belief reluctantly surrendered.

Now we know that the breath is not soul, and that the air inspired performs only ordinary chemical functions.

Mechanism of Respiration.

Let us first look in a general way at the mechanics of the function of breathing. By an elevation of the ribs and a depression of the diaphragm the capacity of the lungs is increased, and the air rushes in, even as air rushes into an expanded bellows. Then the ribs fall, the diaphragm rises, the capacity of the chest is decreased, and the air rushes out at the nostrils and mouth. In health the chest fills about eighteen times a minute, but the rate varies in individuals and with age and other circumstances. The action is muscular, and is regulated by a nerve

centre between the brain and spinal cord, known as the respiratory centre, or "vital knot."

In ordinary breathing, which takes place without the action of the will, about a tenth of the air in the lungs (about 1 pint, that is to say) is expired and the same amount inspired; while in forced breathing about 8 pints of air can be changed at each inspiration. One can thus see that the amount of air breathed in twenty-four hours is very large, and that the oxygen in a small room must soon get exhausted.

Now what is the meaning of this extraordinary phenomenon of breathing? What reference has it to health and energy?

Meaning of Breathing.

Breathing is a process conducive to combustion; it clears away at every expiration, in the form of carbon dioxide, the ashes of old combustion, and it provides oxygen to cause fresh combustion. Air consists of various gases, chiefly oxygen, nitrogen, and carbon dioxide (carbonic acid gas), in constant proportions. Oxygen is the gas that favours combustion, and if a piece of red-hot platinum be put into oxygen it will burst into flame and burn away. Nitrogen is an inert gas—a gas which under ordinary conditions has no chemical effects, and it acts chiefly as a diluent of the other gases. Carbon dioxide, produced by burning charcoal, is in large quantities a poison. When air is breathed in, then, these three gases—oxygen, nitrogen, and carbon dioxide—are inspired in constant quantities. When air is breathed out it is found, on analysis, to contain more carbon dioxide and less oxygen than the air breathed in, and this is the essence of respiration. It is an inception of oxygen and a rejection of carbon dioxide—a blowing in of oxygen to fan the fire of life, and a clearance of carbon dioxide—the ashes of already burnt-up material. Without respiration there would be no energy at all; it is the combustion caused by the oxygen inspired that gives rise to all muscular energy of the body. As George Henry Lewes states it in his "Physiology of Common Life," "Oxygen is the great inciter of vital changes; its presence is the indispensable condition of life. It is at once fuel and flame; it feeds and it destroys; constantly withdrawn from the blood by the activities of vital change, it is as constantly drawn into the blood by the process of respiration."

The oxygen inspired enters into loose combination with the red colouring matter of the blood (which gives to arterial blood its scarlet colour), and is carried by the red blood corpuscles from the lungs

to all parts of the body to be used for purposes of combustion, as required.

The lungs are so constructed as to bring the blood in the delicate-walled vessels on the surface of the tubules within reach of the oxygen inspired, and it has been calculated that in the lungs 2,642 square feet of blood-vessel wall are exposed to the air, and that during a year more than 3,500 tons of blood are oxygenated. Verily a tremendous process, yet so quiet and automatic in its action that we are apt to forget its importance and to ignore its laws.

Over the muscular mechanism of respiration we have little control —it must work, for the greater part of life, automatically, without our interference. Yet, on the one hand, by tight-lacing, by over-clothing, by injurious postures, etc., it is possible to hamper breathing; and, on the other hand, by breathing exercises, by development of the muscles of respiration, it is possible to strengthen it.

Foul Air.

Over the gases which we breathe we have much more control. It lies largely in the power of most of us to increase our bodily vigour by breathing pure air, as to decrease it by breathing foul. Air that has been expired is foul; it contains, as we have said, carbonic acid gas, which in large quantities is a poison; and it also contains other substances of a still more poisonous nature. The Black Hole of Calcutta was an object-lesson to the world. Yet civilised man persists in closing his windows, and inhabits foul, vitiated atmospheres. Not only in the slums, but also in the West End, fresh air is feared; and in churches, where the health of the soul is preached, the health of the body is constantly sacrificed.

Pure Air.

Without pure air, the bodily and mental energy must become low and deteriorate; and the physical degeneration so common in great towns is due as much to bad air supply as to insufficient food supply. More can be done to improve the health of civilised towns by attention to ventilation and sunlight, and by spreading the cult of the open window, than by almost any other means. Forty or fifty thousand people die annually of consumption in Great Britain alone, and the majority of these deaths might be prevented by the very simple expedient of an open window. Fresh air by day and—perhaps even more so—fresh air by night is a necessary condition of full health and vitality.

The blood has been called "the river of life"; but there never was

a river so thronged with ships and barges. It carries, from the forelock to the toes, not only the oxygen to transform matter into energy and waste, but also the waste itself, and the building material of the tissue. The main chemical characters of this marvellous fluid depend on the digestion, on the respiration, and on the cellular activity of the various cellular elements of the body ; but its currents depend chiefly on the mighty muscle known as the heart, and without currents it would be useless as a stagnant pool. The heart is a great muscular sac which shuts and opens, contracts and expands. By its contraction and expansion it drives the blood through the lungs, and then through the general tissues of the body, and, seeing the vital significance of the fluid, the proper action of the heart is of paramount importance. Indeed, let the heart cease beating for only a minute, and a man must die.

The Circulation Energy.

One of the most obvious effects of deficient heart energy is breathlessness, for, as we have seen, the lungs oxygenate the blood, and oxygenation will tend to be insufficient for the needs of the tissues, and for the production of energy, if the heart does not send enough blood to be oxygenated. Hence the lungs endeavour to make up for the weakness of the heart, and for the poor supply of blood, by extra efforts to obtain oxygen, and the man accordingly pants. But even short of panting and breathlessness, deficient action of the heart will deleteriously affect all the other vital energies, and the man with a weak heart will be easily tired, and will lack energy in many ways.

Deficient Heart Energy.

A strong heart is of the greatest value in the battle of life. What can we do to strengthen our circulation ? Firstly, we can feed our heart with good food, by keeping our digestion in good order, and with good air, by looking after our respiratory functions ; and secondly, we can strengthen it, like any other muscle, by exercise. The man who leads a sedentary life, who sits all day long on an office stool or in an armchair, is pretty certain to have a flabby heart, and though it may suffice for his limited muscular activity, it will fail if put to any unusual strain. The man, on the other hand, who has led a healthy, digestive, and respiratory life, and who has been active and athletic, will have a strong heart, which will pull him through severe sickness.

How can the Heart be Strengthened?

Exercise to strengthen the heart must not be excessive ; the heart,

like other muscles, is liable to strain and to fatigue, and many athletes damage their hearts for life by excessive exertion. Where the heart is weak, gentle up-hill walking exercise is best ; and if the heart be organically diseased, the best health can be maintained only by reducing all expenditure of energy.

What is often called a weak circulation—viz. cold extremities—has frequently nothing to do with the circulation at all—or at least with the general vigour of the circulation. Many people are always cold in cold weather, after a meal ; and brain-workers often have cold feet.

The efficiency of the circulation as regards its oxygen-bearing function depends largely on the quantity of red colouring matter which the blood contains ; and any factor—such as fresh air and sunlight—which improves the quality of the blood, also improves the efficiency of the circulation in this regard.

Nerve Energy.

The fourth great root of health is nerve power. This power is not so capable of definition, and the laws which affect its increase and preservation cannot be so directly stated ; it can, indeed, be affected chiefly through the other great functions we have just been discussing. A man underfed, or overfed, a man spending his life in vitiated atmospheres, a man subject to over-fatigue of mind or body, is certain to have what is called a weak or neurasthenic nervous system. The weakness may show itself in emotional irritability, or in physical or mental incompetence, or in some other way ; but a man unhealthy in respect to the first three great energies we have discussed, cannot have strong nerve energies, even though spurts of energy may sometimes convey an erroneous impression to the inexperienced observer. Still, nerve energy is a strange and anomalous energy, and though, as a rule, it varies *pari passu* with the other great energies, it seems sometimes to have the power of persisting when the other energies are at a very low ebb. Energy, as we have seen, depends primarily on nutrition ; and in cases of starvation from lack of food, from heart weakness, or from any other cause, the nerve tissues are the *last* to suffer, and this may explain the anomaly we have mentioned.

But nerve energy, even more than the other types of energy, depends on sleep. Sleep seems especially necessary for the recuperation of nerve power, and a man deprived of sleep will break down nervously, before his heart and respiration and digestion show any marked signs of fatigue.

Given sleep, good digestion, good air, and a heart in good condition, the nerves will usually look after themselves; but there are some cases of nerve weakness which seem primary and quite independent of the other energies, even as the nerves sometimes seem strong even after the other energies have flagged.

Circumstances Affecting Health.

We have now dealt broadly with the nature of the great energies which, in their multiform and inter-related manifestations, constitute health; but there are many other circumstances intimately connected with health. There are such circumstances as sleep, exercise, sunlight, clothing, habitation, stimulants, still to be considered; and we must also consider the special relationship between mind and health.

Sleep.

We have already pointed out the importance of sleep for that form of energy known as nerve force; but for all forms of vital energy, sleep is essential. Without sleep, all the energies must fail. As in the case of food, however, the amount of sleep necessary for health varies greatly in individual instances. There is an old saying, "Six hours for a man, seven for a woman, and eight for a fool"; but this division is not at all in accordance with experience. The only rule with regard to sleep which seems fairly constant, is the rule that most sleep is required in infancy, and least in age, and that the requirements of sleep usually vary proportionately, in the individual, with bodily activity. The infant sleeps most of the twenty-four hours; the growing child, whose muscular activity is intense, and whose tissue changes are very active, requires at least twelve hours' sleep. In old age, again, a very few hours' sleep suffice. In the years between adolescence and old age, one finds great variations. As a rule, we find, as we have said, that the greater the activity the larger the amount of sleep required; but there are notable exceptions. Many men of intense activity, both mental and physical, can maintain health on very little sleep; while other men of lethargic and lazy habits seem to require a great amount of sleep.

Depth of Sleep.

The question of depth of sleep must be considered. It is not a question merely of quantity, but of quantity and quality, and one hour of deep, dreamless sleep may be worth several hours of disturbed slumber. There is a popular belief that one hour of sleep before twelve is worth two hours after twelve, but the belief seems to have no foundation in fact or experience. Those

people who do not retire till the "wee short hours ayont the twal'" may still maintain perfect health provided they sleep sufficiently.

In fine, no law can be laid down for the adult individual as to how many hours' sleep he requires; but there is a minimum which reduced, and a maximum which exceeded, will result in impaired efficiency; and it were well that each individual should find out these limits for himself.

Sunlight.

The sun is regarded by most people as a source of light, as the ripener of corn, and the reddener of roses, but its intimate relationship to human health is usually ignored. Neither plant nor man can survive long without light, and deficiency of light leads invariably to deficiency of energy. The statement of one of Nansen's polar expedition party may be quoted: "The last winter in the ice was *fairly* awful. We had our fill of the darkness. We got sleepy and indifferent, and shaky on our legs. We were not ill, but weak and dead beat, and the doctor was anxious about our brains. When the day came with the sun, it was like a resurrection for us all. We were electrified when we saw him. Nobody knows how fine the sun looks but those who have been six months in darkness. Then we came to strength again."

Even more striking was an experiment made with plants. At Clayton some years ago a certain crop of beans was kept shaded from the sun, and it was found that the offspring were weak, and in the fourth generation became extinct.

Sunlight, then, is a condition of existence. Without sunlight, without the subtle chemical influence of the light waves, both plants and animals would soon cease to be.

Not only is sunlight useful because of its invigorating effects on the higher animal; it is also useful in that it kills germs. Sunlight is one of the best disinfectants. On the other hand, too strong sunlight, too long exposure to the direct rays of the sun, is pernicious, and its evil effects are seen in sunstroke and general debility.

Sunshine, then, must be provided if health is to be maintained, and every effort should be made to ensure that every room in a house receives a certain amount of sunlight.

Man is a more or less mobile animal; his energies result in more or less change of position and posture; and movement is necessary if he is to maintain his health. The heart must move and beat seventy to

eighty times a minute; the stomach must churn the food; the muscles of the chest and abdomen must respire the air; and not only are these automatic movements necessary, but health is hardly possible without movements of the voluntary muscles of the body. We must use our arms and legs, and take exercise, as it is called. The result of exercise is to quicken all the organic processes. The heart and lungs work more strenuously; the lymphatic circulation is stimulated, and there is increased breaking-down and building-up of tissues. The secondary effect of exercise is to increase the habitual efficiency of the energies.

Exercise.

But in order that exercise may be beneficial, it must also be discreet. It must not proceed to fatigue; it must not break down more than the reparative processes can build up. Over-exercise, quite as certainly as under-exercise, results in impaired health, and in this country is perhaps the more common blunder. To direct too much energy into the external muscles is to rob more vital movements of their nerve energy; and hence we find that great athletes often die young, or become feeble at an early age, or succumb to disease.

Precautions as to Exercise.

The object of exercise is not to perform muscular feats, not to develop muscles of a phenomenal size, but to ensure the full and harmonious activity of all the energies, both physical and mental, with a preponderance of either, according to the aptitudes of the individual and the necessities of the case. There can be little doubt that judicious exercise is a good medicine for many ailments, and conduces both to general energy and to longevity. As Dryden sings:—

Object of Exercise.

> "Better to hunt in field for health unbought
> Than fee the doctor for a nauseous draught.
> The wise for cure on exercise depend;
> God never made His work for man to mend."

And as Cicero says: "Exercise and temperance can preserve something of our early strength, even in old age."

We cannot here discuss in detail the rules that should regulate exercise. Suffice it to say that exercise is necessary, and that exercise should be judicious.

Health is holiness, and cleanliness is next to godliness. An unclean man is necessarily an unhealthy man, for the full functions of the skin

are impossible if the skin be unclean ; and the full functions of the skin are necessary for full health. We treat the functions of the heart, and of the lungs, and certainly of the liver, with a good deal of respect ; but the functions of the skin are usually pretty much disregarded, and the clean man who has his morning bath takes it for æsthetic rather than for hygienic reasons. Yet the functions of the skin are important functions. Not only is the skin the great organ of tactile, muscular, thermal sensation ; it is also a great excretory organ, and a great regulator of bodily temperature. All day long and all night long water is insensibly passing through the skin. It has been calculated that there are about twenty-eight miles of tubing connected with the surface of the human body under ordinary conditions, and that 25 pints or more of water are evaporated from the skin of an average man under average climatic conditions, while under great heat as much may be lost in an hour. This efflux of water helps both to eradicate poisons from the system, and to regulate the temperature of the body. Moreover, the skin respires ; a certain amount of oxygen is inspired by the skin. Any dirt, any secretions, any pomades or cosmetics, therefore, that clog the pores of the skin interfere with big processes, and are detrimental to the health of the organism ; and the warm bath must be considered one of the necessities of health.

Cleanliness.

Functions of the Skin.

The skin of men is not protected, like the skin of most animals, with a coating of fur ; its hairs are tiny and insignificant ; therefore man in temperate and cold climates has found it conducive to health to assist the maintenance of a steady bodily temperature by covering his skin with garments to keep out the wind and the rays of the sun, or to keep in and economise the heat formed by the natural processes of the organism. Wisely managed, the expedient is useful to health ; it enables the combustibles of the tissues to be used for other than heating purposes, and it preserves the body from extremes of heat and cold which diminish its energy and sometimes increase its liability to germ diseases.

Clothing.

But the question of clothing as a health measure is usually dealt with in a very casual and perfunctory manner, and errors in clothing are undoubtedly responsible for many physical ailments—for skin disorders, for liability to cold, for general debility, for indigestion, etc. The mother enswathes her baby in as many coverings as a mummy,

and then wonders that the baby ails. The smart and foolish young woman laces her waist till it measures, perhaps, 15 inches, and then wonders that her digestion is bad and her nose rubicund. The fashionable dame trails her long skirt on a germ-laden pavement, and then wonders who brought the cold into the house. As a rule, too many, too heavy, and too tight clothes are worn, and Dr. Cavanagh quotes with approval the opinion of the King of Cambodia, who, after a visit to Europe, stated : " European women wear far too many clothes. They should wear no more than two garments, one fitting close to the skin, the other covering the first. Besides, they harness themselves too tight ; at least their legs should be free."

A man protects his skin not only with clothes, but with houses, and the architecture of the houses is as important as the cut of the garment, and should be inspired by much the same aims. Unfortunately, as in garments so in houses, æsthetic considerations are usually allowed to outweigh hygienic advantages ; and it is quite a common thing to see a handsome and spacious house with picturesque but puny windows. Now, above all things, a house ought to have large windows to admit plenty of sunlight and plenty of fresh air, for without sunlight and fresh air the inhabitants cannot thrive. A house, too, ought to be thoroughly dustless and clean ; and to carpet a room with thick, dusty carpets, and to crowd it with more or less useless and ornamental furniture, is as unhygienic as it is barbaric. A room—and especially a bedroom—should be furnished as simply as possible, and it should be as speckless as a plate, for it is the plate from which our lungs take food. A war against rats is now being waged ; but a crusade against unclean houses is still more required, and might do a good deal more to augment the sum of human health and energy, for unclean and ill-ventilated houses, more almost than anything else, are the causes of common colds, and of the white plague, consumption.

Habitation.

In connection with habitations, the site of the building must also be considered, and it is usually agreed that a well-drained site, sheltered from the north-east and open to the sun, is desirable. A gravelly or sandy soil is the healthiest.

Byron, with his wonted cynicism, declares–

> "Man, being reasonable, must get drunk ;
> The best of life is but intoxication."

and though the reasonableness of getting drunk may be doubted, its universality is indubitable. Man in all climes and at all ages has craved stimulation. Nor is the desire altogether morbid. The desire for stimulation is simply a recognition of the desirability of energy. The danger, of course, is that the stimulation may be followed by depression, and the depression by a consequent craving for stimulation, until a vicious circle is commenced which is the eddy of a whirlpool of destruction. Even excessive tea-drinking or coffee-drinking may result in great deterioration in both mental and physical faculties. When stimulation is really required, probably the best and least dangerous of stimulants is a hot decoction of the extractives of meat, such as ordinary beef-tea ; but the healthy man living a healthy life will require no stimulants of any kind, and a reckless indulgence in stimulants is incompatible with good health.

Stimulants.

No discussion of the laws of health can be complete without consideration of the mental aspect of the question. The mind and the body are inseparable, and even as disorders of the bodily functions sometimes disturb the higher intellectual centres, so conditions of the mind also affect the body functions.

The Mental Factor in Health.

Hippocrates included among the six articles indispensable to life "the passions and affections of the mind"; and Dr. Parkes, in his well known "Manual of Hygiene," writes : "Taking the word hygiene in the largest sense, it signifies rules for perfect culture of mind and body. It is impossible to dissociate the two. The body is affected by every mental and moral action ; the mind is profoundly influenced by bodily conditions. For a perfect system of hygiene, we must train the body, the intellect, and the moral faculties in a perfect and balanced order." And no consideration, however general and cursory, of the laws of health can be complete without some reference to its relationship to the mind.

Everyone must have been struck by the way in which the bodily health deteriorates under the influence of worry. "Care killed the cat," says the proverb ; and care has certainly killed hecatombs of men. In many cases the disease from which the patient suffers is nothing more nor less than worry, and the disease can be cured only by removing the cause of the worry. Sometimes the worry is inevitable : the cause is beyond the reach of even surgical interference ; but in other cases

the worry may be within the control of the will, and in such cases it is the duty of the wise physician to ensure its removal.

Even as care injures health, so happiness improves it. The medicinal value of good news is proverbial, and every doctor knows that determination to get well facilitates recovery. Unfortunately, however, as the wise Seneca said, "Pars sanatatis velle sanari fuit" (The will to get well is part of health), and those suffering from severe illness usually lose all desire for life.

Happiness.

One of the most common worries affecting the health is worry about health itself. As the poet Churchill has it :—

> "The surest road to health, say what they will,
> Is never to suppose we shall be ill ;
> Most of the evils we poor mortals know
> From doctors and imaginations flow."

The hypochondriac worries over trivial disorders, and the worry causes a condition of depressed health which aggravates the disorders, and so things go from bad to worse ; but let a great altruistic interest, or let even a Christian Scientist, possess his thoughts, and with the cessation of worry the health will improve and the disorder, often nervous in its nature, will disappear.

To sum up : A man who would attain the maximum health of which his body is capable, must take measures to assist the normal action of his heart, digestion, lungs, and nerves ; must see that he sleeps sufficiently, suns himself sufficiently, exercises himself sufficiently, and is well and wisely clad and housed. He must in addition avoid stimulants, and he must, so far as possible, cultivate a cheery mind. By such measures he will, at least, make the most of the energy, mental and physical, with which he was originally endowed.

CHAPTER LXXVI

THE SUCCESSIVE AGES OF LIFE AND THEIR SPECIAL REQUIREMENTS

Infancy : Breast-feeding—Substitutes—Quantity of Milk—Number of Meals—Weight — Cleanliness — Clothing — Air—Sleep—Quiet — Teething. Childhood : Kindergarten—Exercise—Food—Sleep—Clothing—Bathing—Care of Teeth. Youth : School Life—Medical Examination—Exercise—Food—Sleep—Clothing—Deep Breathing. Early Adult Life : Marriage—Hobbies—Diet—Holidays. Middle Life and Old Age: Back to the Habits of Childhood.

The preservation of health at different ages and under varied conditions of life is largely a matter of common sense. Preventive medicine is a comparatively new science, but it looms large in importance to-day, and public opinion is gradually awaking to the fact that disease after disease is falling within its scope, from simple indigestion due to improper food to consumption of the lungs due to improper air.

The preservation of personal health is, then, largely preventive. Each stage of life presents different dangers, and if these are recognised and guarded against, evil consequences may be prevented. With this object in view, we will consider a healthy life in its various stages—infancy, childhood, youth, early adult age, middle life, and old age.

INFANCY

A good start is of the greatest importance, as any defect may leave its mark throughout the whole life of the individual. This goes back to the very beginning of life, and means that the parents must be healthy, pure, and non-alcoholic, and in addition the mother must live a wholesome, calm, and self-controlled life, with plenty of fresh air, simple food, and pure water during the period before the child's birth.

The good start must be continued after birth, and a gradual acclimatisation to the new conditions of existence must be accomplished.

Respiration and circulation are suddenly and radically altered; the environment of warm fluid changes to a dry atmosphere at least 30° lower in temperature; the delicate skin receives the shocks of handling and rapid movement, and new sensations abound. Warmth and quiet are therefore the two first requisites, and nourishment, after forty-eight hours.

Food. Nature is the best teacher, and she supplies hardly any milk for the first two days, because it is not needed. Every eight hours the first twenty-four hours, every six hours the second twenty-four hours, and for five minutes only, is the limit of feeding from the mother's breast during the first two days of life. If the child is restless, one or two teaspoonfuls of warm boiled water may be given. When the third twenty-four hours begins, Nature teaches that more food is required, and then the child should be fed every two hours from 6 a.m. to 10 p.m., with only two feeds in the night, and these reduced to one as soon as possible.

That the newborn infant should be given the food that Nature has provided for it is self-evident, and it should be looked upon as a crime to withhold or lightly suppress this birthright of the child.

England bewails her diminishing birth-rate, but let her take to heart her appalling death-rate of infants under one year; it is of far greater national importance. Almost all these infants that succumb are hand-fed, and it has been shown that the greater number die of ailments due to digestive disorders, although infectious diseases claim their share.

Breast-feeding. Breast-fed infants are practically immune from infectious disease, and their greater vitality is continued into adult age; while the peculiar bond of affection between the mother and her child makes for great and lasting good in the character. It has been well said, "You cannot rear an imperial race on the bottle."

It is, therefore, a mother's sacred duty to supply her child with its natural food for the first few months of life, and to this end she must use intelligent and self-denying common sense, taking larger or smaller quantities of good plain food and milk as needful for the child's normal growth, keeping strictly to the regular feeding hours, and subordinating everything else to this supreme responsibility, although other duties must not be overlooked, and a fair amount of physical work and exercise is indeed necessary for her own health.

If, for absolutely unavoidable reasons, breast-feeding is impossible, a substitute must be found, and this substitute must closely resemble

the original—at least for a permanent diet. Closest of all comes the milk of another human mother, and this is invaluable in the case of a premature or delicate child. Next comes the ass, whose milk is peculiarly easy to digest, but too weak for any but temporary use without the addition of extra protein and fat. Cows and goats rank together, but in most countries the milk of the former is more easily obtained. Both these milks are richer in proteins than is human milk, but about the same in fat and sugar. The goat has the advantage of being almost proof against tuberculosis, and of being far easier to keep clean and look after, besides being much cheaper to feed. In many places infants are suckled direct from the goat's udders, obviating one of the greatest risks of all substitute milks—that of introducing disease germs through the necessary manipulation in the conveyance of this most easily contaminated fluid.

Substitutes.

That infants should have milk *direct* from the secreting organ means that the all-important vital principle of life is present, but this appears Utopian at present. Until the cow can have at least its udder and teats made aseptic, be milked by aseptic machinery into small sterilised vessels which are hermetically closed by sterile covers and are conveyed direct into the household without further handling—until this can be done it is not safe to administer cow's milk to infants without first killing the germs that have inevitably entered through countless loopholes in even the strictest code of dairy cleanliness.

Nearly all germs can be rendered inert by simply boiling—i.e. by bringing the milk to the boil with stirring—and it should be then poured into a clean jug which has just been scalded out with boiling water. The top should be covered with a piece of boiled linen, and the jug placed in a basin of cold water to cool rapidly. It must be used within twelve hours. It is safer, especially in large cities and in hot weather, to buy a little cruet frame, with special bottles, and to pour sufficient milk or milk and water for one meal into each bottle, placing an indiarubber cap over the top. Lower this into a saucepan of cold water, bring the water to the boil, and keep it boiling about forty-five minutes. Take out the cruet without touching the caps, and place in cold water to cool. This milk is *sterilised*, and will keep twenty-four hours. If preferred, the saucepan can be removed from the fire as soon as the water boils, and the bottles allowed to remain in it for twenty minutes before cooling. This milk is *Pasteurised*, and will keep twelve hours, but unless the

milk supply is thoroughly beyond suspicion—and it must be remembered that a slip in the cleanliness of one cow's milking may affect all the milk of a large dairy—it is less safe, as it does not kill the germs.*

When a meal is required, a bottle is taken from the frame and placed in a jug of very hot water for a few minutes. The cap is then removed, and a recently boiled teat is instantly slipped over the neck of the bottle, which is then ready for the child. Needless to say, the teat must not be placed in the mother's mouth first, or it will indeed be a veritable hotbed of germs, and probably will introduce some into the child's stomach that will cause fermentation and putrefaction of the whole meal.

All bottles, teats, and caps must be boiled every day. Tube bottles are inadmissible, as it is impossible to keep the tubes really clean. The child's mouth should be washed out at least three times a day with a piece of clean boiled linen dipped in boracic lotion. This is made by putting 1 ounce of boracic acid crystals in a bottle holding 1 pint of boiled water, and well shaking it. When the child's saliva is secreted in sufficient quantity—at about six months old—the washing need only be done night and morning.

Quantity of Milk.

The exact amount of milk required differs according to the age and weight of the child. Roughly speaking, each day about one-eighth of an infant's body-weight of good milk containing 4 per cent. of fat is needed. This may require augmenting to one-seventh or decreasing to one-ninth, and the weight chart will reveal the individual amount needed.

Number of Meals.

This quantity of milk must be divided into ten meals a day the first month, nine meals a day the second month, eight meals the third and fourth months, seven meals the fifth, sixth, and seventh months, and six meals afterwards, never allowing more than one of them to be taken during the night—i.e. from 10 p.m. to 6 a.m., and as soon as possible none at all.

The milk should at first be diluted with an equal quantity of water added before sterilisation, but less and less water should be added until it can be taken pure. It has been proved that small meals of undiluted milk are better for infants over a month old than larger ones of diluted milk.

* Different forms of sterilising apparatus can be bought quite cheaply.

Should fresh cow's or goat's milk be quite unobtainable, the best substitutes are desiccated or dried milk and unsweetened condensed milk, but these are unsuitable for a prolonged diet, as the fresh, vital principle is absent altogether.

Nature has clearly taught that *milk* is the only correct food for seven or eight months ; before that time there is no ferment secreted to digest starch, and starch is present in greater or lesser degree in most of the foods directed to be mixed with milk. After seven or eight months a little starch may be added to the milk once or twice a day, and the best foods for the purpose are those which predigest most of the starch, such as the malted foods. Children do not digest starch readily before two years of age, and are frequently overfed with this constituent, and lamentably underfed in proteins (for example, red gravy and white of egg), and also in fats (for example, cream, butter, and yolk of egg). Up to this age at least 1½ pints of milk should be taken each day.

Weight.

An infant's weight should follow a normal curve, according to its original birth weight. Charts are sold with this normal curve printed in red ink upon them, and the child's actual weight should be recorded in black ink. If much above the curve the child is, probably, being overfed, and is unhealthy and possibly rickety. If much below the normal, it is probably being underfed or improperly fed. The actual gain should be as follows :—

1st and 2nd	months the	increase	should be	6 to 7	ounces	a week.
3rd and 4th	,,	,,	,,	5 to 6	,,	,,
5th and 6th	,,	,,	,,	3½ to 4½	,,	,,
7th and 8th	,,	,,	,,	2½ to 3½	,,	,,
9th to 12th	,,	,,	,,	2 to 2½	,,	,,
12th to 24th	,,	,,	,,		½ lb.	a month.

This gives roughly the birth weight doubled at five months and trebled by one year.

Cleanliness.

A child, after a week old, should have a bath night and morning, as it is important to keep the skin acting well. The evening bath should be at a temperature of 100° or 101°, and the morning one gradually lowered until it is 80°. After two months the skin should also be trained to become insensitive to chills by rapidly passing a sponge, wrung out of colder water, over the chest and back, and by letting the skin be exposed to the air for a few minutes after

bathing while the child kicks about. A good superfatted soap should be used and the water should, if possible, be soft.

Clothing must be arranged on strictly hygienic lines—i.e. to prevent the body heat from escaping too freely, but without causing perspiration.

Clothing.

A layer of woven or knitted wool should cover the skin. in the form of a long vest reaching from the collarbones to below the hips, with sleeves to at least the elbows. Over this a knitted or woven binder must be applied to the sensitive abdominal organs. The napkin is best made of cotton-wool tissue, burnt after use. The upper garments should consist only of a flannel petticoat and thin woollen or silk frock, coming 5 or 6 inches below the feet to prevent draughts. As the child grows, and is able to take exercise by kicking, the clothes can be shortened, but the legs and thighs must be kept well covered with knitted drawers placed over the napkin and firmly attached to the binder, which should always be worn for the first two or three years of life. When the child is lying in a perambulator, very warm wraps are required in cold weather, and a hot-water bottle should be inserted near the feet. Shetland shawls are far better than cloaks.

Air.

The oxygen which an infant has been accustomed to obtain in full quantity from its mother's blood must now be supplied through the air, and many children get bronchitis and other illnesses from not being supplied with it in sufficient quantities. Less than 1,000 cubic feet of air to each child or adult should not be tolerated, and even in this case the whole of the air must be changed every few hours, by opening all doors and windows and creating a strong draught. The child, in its cot, can be entirely covered during this process.

It is also of importance, while keeping a child warm—with hot bottles if necessary, so that its limbs never feel cold to the touch—to accustom it gradually to breathe cold air. This must be through the nose, and not through the mouth, for the former channel warms and filters the outer air before allowing it to pass into the lungs. A child's mouth should be shut and be kept shut always when asleep—a habit easily learnt if taught from birth. A temperature of 55° to 60° is quite warm enough a week after birth, and summer babies may be put to sleep out of doors all day protected from sun, wind, and flies, after a fortnight, and should be near an open window, protected from direct draught, all night. If brought up in this way, a child can sleep practically out of doors in fine weather all the year round with great advantage to health.

A healthy baby's time should be divided between feeding and sleeping, with an occasional fit of crying to expand the lungs. After a few weeks there will be longer periods of wakefulness, but contented wakefulness, the child happy to lie in its cot and watch the sunlight or a coloured ball hung near by. No rocking or patting should be allowed, and no nursing, except for half an hour before the evening bath to give exercise. After each meal a child should be laid in its cot on its right side, never on its back, for fear of its being choked by regurgitation of food. Its mouth should be closed, and it should be left to its meditations, or cooings, or sleep, as it prefers. This rule adhered to all througn childhood may turn the scale in a serious illness, when quiet rest may be all-important.

Sleep.

A young child should never sleep with an adult, and in some places it is illegal. It is a dangerous habit from the frequency of overlying, and it is an unhealthy habit, as the child's head is below the bedclothes, and it breathes germ-laden air from the exhalations of the mother.

It is very important that quietness should be obtained for an infant. Its nervous system should not be stimulated. Impressions should be gradually absorbed, not directly imparted by much talking to or the showing of objects, etc. At the same time any striking deviation from the development set out below should suggest a skilled examination, as the child will certainly be backward if not actually deficient in intellect.

Quiet.

STAGES OF DEVELOPMENT

At 2 *months* a child should take some notice of coloured things and follow them with his eyes ; should smile when pleased, and coo to himself.

At 4 *months* he should be able to hold the head erect, know his mother's voice, grasp at things, show active signs of pleasure.

At 6 *months* he should be able to sit up, begin to be shy of strangers, begin independent investigation by sight, touch, and taste.

At 8 *or* 9 *months* he should begin to imitate, use syllables without meaning, though gradually learning to associate words with things.

At 12 *months* he should indicate many objects correctly, say a few words, and understand many more.

At 18 *months* he should walk, enjoy coloured pictures, couple words together.

At 2 *years* he should run about, have a vocabulary of several hundred words, and use simple phrases correctly. The hole in the front of the skull should be closed.

The dangers to which infants before the age of seven or eight months are liable are—Breast-fed babies, practically none. Hand-fed babies,

digestive troubles due to germs in the food, to chill to the abdominal organs, and also to infectious diseases due to the lack of resistance of the tissues to germs accidentally inhaled or swallowed.

Dangers.

Teething marks a later stage, from about seven to twenty-four months, but it is a normal process, and to a normal child should mean very little discomfort. The teeth should appear as follow: Seventh month, two middle teeth in the lower jaw, quickly followed by the corresponding upper ones. At about eight months, one tooth on each side of the central ones. At about twelve months, four double teeth. At about sixteen months, the four eye teeth; and at two to two and a half years the other four double teeth, making twenty teeth in all.

Teething.

It is most important that the daily mouth washing of the infant should be continued as teeth cleaning as soon as there are any teeth to clean, a soft brush being substituted for the finger and linen. A settled habit will thus be established which will save many a tooth from early decay.

CHILDHOOD

It is convenient to take the period of childhood as from two to seven or eight years. It is a most interesting and important age, in which should be laid the foundations of character—of obedience, self-control, truthfulness, unselfishness, reverence, etc., and no haphazard methods should be tolerated.

The exact age for a kindergarten school differs according to whether the child is an only one, or a member of a large family. In the former instance, the companionship of equals in age is almost a necessity after five years old. Corners are rubbed off, fair play is taught in the most effectual and simple manner, and life ceases to be centred on the *ego*, but broadens out insensibly. At the same time, the infectious diseases of childhood—*e.g.* whooping cough and measles—must be expected to be often introduced through schools. In choosing a kindergarten school a great point should be made of plenty of air space and good ventilation.

Kinder-garten.

There should be no poring over small print or fine work at this age, but plenty of bold outline, whether with a paint brush, pencil, or needle. Learning to read demands a special word. One quarter of an hour a day, beyond any kindergarten work, should be devoted to this from

six years of age, especially with boys, who are curiously slow in its acquisition, many being hampered for years by the inability to read quickly. Reading must be learnt individually, and is therefore better taught by the mother than in a class.

At this period the education of the senses must be the aim, carried out mainly by play lessons most carefully thought out. Sight, especially long sight, observation, hearing, smelling, feeling can thus be developed, to the child's immense advantage in after life, while useful games—such as dolls' bed-making, table-laying, dusting, etc.—have their distinct place, and of course gardening heads the list.

Exercise should consist almost entirely of outdoor games, drilling proper—except in the simplest forms—being relegated to the next period.

Exercise.

Breathing exercises and skipping to develop the lungs, and tip-toe exercises to prevent flat-foot, are valuable.

Food.

The diet list must be carefully thought out. Two pints of good milk should be the daily allowance up to five years of age, and 1 pint afterwards. It must be remembered that all growing children require food not only to provide heat and energy, which are common to all, but for building up fresh tissues, which adults can disregard, and also for repairing waste, which is a large item in restless childhood. Carbohydrates, such as starch and sugar, children generally have in sufficiency or even excess ; it is the proteins and fats which are frequently deficient, especially the latter, which help to feed the nervous system and make strong bones. Three times daily children should have a due proportion of solid protein and fat with their carbohydrates, and for lunch and supper milk and carbohydrates only. The protein need not necessarily be in the form of meat ; eggs, fish, red gravy, plasmon, haricot beans, and lentils can all be utilised ; and for fats, plenty of butter and cream, with eggs.

Food faddists should not be allowed to experiment on children ; an adult can get enough heat and energy out of a diet which would starve a child with its entirely different requirements. It is better for young children to feed apart from adults, unless they are so well trained as to be content to eat what is given them without hankering after indigestible dainties. No highly seasoned or elaborate food and no tea or coffee should be allowed, and it is of the greatest importance to teach a child to eat slowly and thoroughly masticate its food.

Sleep is of almost equal importance to food in ensuring a healthy

childhood. To sleep the clock round is not too long up to seven or eight years old, and if two children sleep in the same room, talking after the light is put out should be absolutely forbidden. A rest for one hour in the middle of the day, in a darkened room, should be persevered in until five years old. Wide-open windows should be the rule, and in winter or foggy weather a piece of gauze tacked over the window filters the air of smuts.

Sleep.

Night terrors, in which a child an hour or two after bedtime begins to scream and yet appears half asleep, can generally be traced to some nervous excitement during the day, such as a thrilling story or a game of wild beasts, or they may occur soon after beginning school life. They are an indication that the child's nervous system is unstable, and are often accompanied by muscular twitchings of the face, excessive terror of ugly sights and sounds—Punch and Judy shows, or effigies of Guy Fawkes—and great fear of fire, trains, or animals. Such a child needs the wisest management. Between the attacks of fright he should be quietly reasoned with and encouraged to exercise self-control, and then be patiently persuaded to look at or listen to the obnoxious thing, being praised for each success. A child of this temperament requires, even more than others, a calm quiet routine with very little variation, plenty of milk and cream, with a free, open life, and a wise mother or educated nurse at the helm. Such children are often precocious and clever, but the temptation to let them recite or " show off " must be sternly resisted. Without this care they will grow up unbalanced and hysterical.

To prevent undue radiation of heat from the surface is the main indication for this period of life, and therefore the rational clothing for both boys and girls consists of a woven combination from neck to knee, stockings, warm woollen knickers and bodice, and an over-dress or tunic. Uniformity of warmth must be attained, and no more clothing be worn over the chest than on the abdomen and thighs. Coats in cold weather should reach below the knees, but a child that can keep itself warm by vigorous exercise with a hoop or skipping rope requires very little extra clothing out of doors, though if sitting in a mailcart or going for a drive it needs plenty of wraps.

Clothing.

At this age an evening bath at 100° is necessary for cleansing purposes, and in the morning it is best to stand the child in a basin of warm water and give a rapid sponge down with cold. This should not take longer than one minute, and should be followed by a good rubbing with a

rough towel. Then, before dressing, a run round the room in a state of nature should be allowed, gradually lengthened, by introducing some skipping, as the child grows older. This will help to harden the skin and lessen the liability to catch cold. By five years old, or earlier, a jump in and out of the large bath half filled with cold water should replace the sponge down ; the water should entirely cover the child but the immersion be momentary only, and the same rubbing down and exercise should follow. Runs or skipping round the garden, without any cap or coat, should be indulged in regularly all through the year, but stout shoes should be worn.

Bathing.

The permanent teeth should appear as follow :—

7th year, four first double teeth.
8th and 9th years, eight central teeth.
10th and 11th years, eight side teeth.
12th year, four eye teeth.
13th year, four back double teeth.
17th to *25th years*, four wisdom teeth.

A point sometimes forgotten is the necessity for visits, at regular intervals, to a dentist. These visits should begin at two years old, and their frequency should be decided by the dentist. A cavity should be stopped as soon as it is discovered ; to wait until the tooth aches is probably to lose it. It is a false idea that the temporary teeth do not matter ; the condition of the permanent teeth depends greatly upon their predecessors. Sometimes the permanent teeth are too crowded, and a good dentist may wisely advise the removal of some to give room for the others. The regular brushing and cleaning of the teeth at night should never be omitted, and should be considered as essential as the bath and breakfast. Good or, for that matter, bad habits solidly formed during this period tend to be lifelong.

Care of Teeth.

YOUTH

From the age of eight to that of twenty-one years may be called the school and college period. At eight years old a healthy child should be sent, if possible, to a preparatory day school, and the parents should carefully consider the position. If they are wisely determined to give the children as good an education as possible, they must not be content only to choose the best schools and then loyally to uphold their authority, but must be prepared to fit in home surround-

School Life.

ings so as to assist and not hinder the school course. The breakfast hour may have to be made earlier, for the children must have a comfortable and superintended meal before starting. Lunch must be thought of beforehand, unless bought at school, while it may be well to hear again some of the younger ones' lessons. The hours for the other meals may have to be readjusted, and on return from school a quiet room with no distraction should be provided for the home-work. Until a child can be trusted to prepare his lessons thoroughly alone, supervision should be provided, or work which it is calculated should take one hour will last two or more, from the want of concentration. The cry of "overwork" is frequently due to this lack of parental investigation and foresight.

No social invitation should be accepted during term time except on a holiday, and, in fact, the children's education should be looked upon as their business in life, and, as such, of supreme importance.

The school, if conducted on modern lines, will probably give several recreation periods in the playground, and if the child has a properly acclimatised skin, no wraps are required; used intermittently they are dangerous.

At about twelve years a large public school is best for both boys and girls of the middle classes. It widens the outlook, and gives a *camaraderie* and *esprit de corps* which develop the character, while it generally provides a chance of scholarships which will lessen the expense of specialised education after seventeen or eighteen. The school games are also of great service in developing self-control, resourcefulness, and leadership, in addition to the useful exercise they afford.

The curricula of such schools are carefully arranged for average children, and many delicate children improve in health from the regularity enforced; but should they be found to have muscular twitchings, to talk or walk in their sleep, to develop general nervousness, and lose interest in games, it may be necessary to remove them, at least for a time, to a country or seaside school, where such children are specially catered for.

Town children should, whenever possible, have a few days at the sea during each holiday to brace them up for the ensuing term.

At many schools every child is medically examined on entrance, and any defects of sight, hearing, chest expansion, or muscular development are noted, the parents being advised as to treatment. Parents

should, otherwise, have this done on their own initiative, as such defects should be remedied before serious mischief follows. Particular attention should be directed to the frequent presence of growths at the back of the nose, known as adenoids, with which are often associated enlarged tonsils. They cause the mouth to be kept open, as nasal breathing is insufficient, and snoring, deafness, and a general mental dulness are often noticed. They are easily removed.

Medical Examination.

Headaches are often due to errors of vision, and if so they will be cured by suitable spectacles being worn. Faults of posture must also be noted and corrected, or spinal curvature may occur.

Exercise.

The amount of drilling and outdoor games must be regulated by the strength of the child, and be increased gradually. No fixed apparatus —such as parallel bars, vaulting horse, etc.—is suitable for girls under fourteen, or for small, loose-limbed, or rapidly growing boys; but exercises with light clubs, dumbbells, barbells, skipping ropes, and balls are most useful for both sexes. Special exercises to develop the different muscles should be taught, perhaps the most important being those to strengthen the abdominal muscles. These will be mentioned again.

When boys are about sixteen or so, regular gymnastic work is of the greatest value; in fact, some form of hard exercise is absolutely requisite for health at this period of life. Different forms of exercise should be learnt, if possible, during youth, such as cycling, riding, rowing, swimming, and skating, but they must not be indulged in to excess, as long-continued muscular effort is known to strain the heart severely. Boys and girls should be taught to love walking, and to avoid trains and trams when it is possible to walk the distance.

The school period is the time of the greatest bodily growth, and also includes the change from childhood to youth known as puberty. To have any great strain, either mental or physical, until this is accomplished is unwise, but at the same time the life should be full of outside interests to prevent a morbid introspection.

A healthy boy or girl should gain 7 to 8 pounds and grow at least 2½ inches a year, from about ten years old to sixteen, although many attain to their full height at a year or so younger.

The food in this period must be very nutritious, with a special allowance of proteins and fats. The midday meal is often curtailed by

reason of time or expense, and therefore an evening dinner at 6.30 or 7 p.m. is frequently advisable after twelve years. Tea and coffee should not be allowed at this meal, as they lessen the nutritive value of fresh meat.

Food.

Girls are liable to a form of poorness of blood from fourteen to twenty-one, causing headaches, depression, and shortness of breath, and they need foods rich in iron, such as underdone red meat, oatmeal, eggs, spinach, and apples. If they are markedly pale inside the lips and eyelids, some form of iron should be given with food for long periods at a time. Milk should be taken, either alone or in the form of tea, coffee, or cocoa made entirely with milk. If the last meal be at half-past six, a cup of milk food should be given before going to bed ; and if breakfast is early—say at eight o'clock—and lunch not until two o'clock, a glass of milk and biscuit or chocolate between these meals should be insisted upon. No stimulants should be given except in illness, and no smoking allowed before eighteen or twenty, while a youth is far better for not acquiring the habit at all. The last heavy meal should be taken at least two hours before bedtime. Chilblains would indicate an increase of fat in the food—e.g. a daily allowance of cream, or cod-liver oil with or without malt, as preferred.

Sleep.

Sleep is, at this period, of equal importance with food, and many of the boarding schools are now altering their rules to allow of longer hours. From eight to eleven years, eleven hours ; from eleven to fifteen years, ten hours ; and from thence to twenty-one years, nine hours are the minimum quantities, to be supplemented by extra time once a week or so.

The bedrooms must have wide-open windows, and this will help to counteract the bad effects of a perhaps insufficiently ventilated schoolroom. Headaches are often due to lack of sufficient sleep and open air, or to eye strain as before mentioned.

Any period of unavoidable special strain—e.g. a competitive or public examination—demands increased vigilance by the parents, as extra sleep is of supreme importance, and also an extra supply of fresh air by rides into the country on trams, etc., and an extra supply of easily digested food.

About sixteen or seventeen some public examination in general subjects, qualifying for entrance into most of the professions, should be taken as an ordinary part of the school curriculum, and until this is

passed no "specialising" should be allowed. Afterwards the special training for the future career must be entered upon, and it is the truest kindness to provide both girls and boys with some profession, business, or trade for which skilled labour is required, and then to spend two or more years in preparation before expecting any return. Many can never rise in their professions because they neglected to train sufficiently while young enough to do so.

Children who have had the misfortune to have illnesses which leave marks on their constitution—rheumatic fever, for example, which leaves a weak heart—or who have a tubercular tendency, will require special consideration and, if possible, medical advice as to their careers.

Clothing.

Clothing should still be designed on hygienic principles—i.e. an even distribution of warmth and no pressure. Experts condemn both sailor and Eton suits for boys as leaving exposed the most vulnerable parts of the body. With this exception, if woollen pants are worn as well as vests, boys are generally clothed more suitably than their sisters. Girls should not be allowed to wear boned corsets, and should have woollen combinations from collarbones to knees, and a stay bodice to which are attached suspenders for the stockings, knickerbockers of dark serge with removable linings, and a dress. While short dresses are worn the knickerbockers should be of the same material. No petticoats are required for everyday wear, and all dresses for the same purpose should be at least 4 inches from the ground all round. Boots and shoes should be broad and have low heels.

The youth of both sexes should be taught that much of their health and happiness depends upon themselves, and they should understand that such simple hygienic rules as are indicated in this chapter cannot be disregarded with impunity. The care of the skin and teeth as described under Childhood should be attended to punctiliously, and a few muscular exercises carried out each morning after the cold dip will be of the greatest value, especially in cases where there is much sedentary work.

The subject of exercises is dealt with in detail in other chapters, but here it may be pointed out that the abdominal muscles should especially be exercised to assist the daily evacuation of the bowels, which is necessary to health, and a glass of water, hot or cold, drunk each morning on rising, is useful. Simple bending of the body from the waist, the knees being kept stiff, both downwards, backwards, and sideways, and, again, turning round the upper part

of the body from side to side as far as possible while keeping the hips and legs fixed, are both useful exercises, to be practised standing. Better still is it to lie flat upon the ground and pull up to a sitting posture without any assistance from the arms or raising the heels from the ground. This should be done several times, as also the exercise of lifting up the legs to a position at right angles to the body, while lying on the floor, and lowering them to within a few inches of the floor, repeating this manœuvre several times before allowing the heels to touch the floor. Five or ten minutes spent in this way is time saved in the long run.

Deep Breathing.

Young people should also be taught the value of deep breathing in pure air, so as to flood the lowest recesses of their air vessels with fresh oxygen. This may have to be done on the top of an omnibus, or before an open window. Dwellers in flats should remember that to run up the stairs is better than to always use the lifts, for the internal muscles need use as much as the external, and boys and girls leaving school with its energetic physical exercise soon get out of training unless they take the trouble to use their heart and lungs in less pleasant, perhaps, but still efficacious ways.

To sum up: With plenty of sleep, plain food, pure water, and fresh air day and night, and with active outdoor exercise for one or two hours daily, our boys and girls should have a healthy and thoroughly enjoyable school and college period.

EARLY ADULT LIFE

This is the period when life is at its zenith and the body and mind should be exercising their greatest activity, and as by twenty-five the tissues will have finished growing, and are endowed with a wonderful amount of elasticity, the capacity for work is at its greatest. It must be admitted that although, of course, excessive strain of any one part is to be deprecated, yet the above mentioned elasticity will allow of recovery in a manner quite impossible at either an earlier or a later stage of life.

Marriage.

All functions being at their best, this is the most suitable time for marriage, which should not be unduly delayed. Nowadays many things are considered necessities which were formerly looked upon as luxuries, and to secure them the age of marriage in the middle classes has been pushed later and later, to the immense detriment of the coming generation.

It is a great thing to have a definite object in life. This does not

apply so much to men, as they are usually well provided for in this respect; but if a woman has not been given the chance of a profession or business she is very apt to develop various nervous affections due to lack of occupation and ennui.

Hobbies. However much a man may be engrossed in his business—and now is the time for toil—he will do well consistently to cultivate a hobby of a nature totally different from his work, and if this be of a sedentary nature, the more the pursuit of his hobby takes him into the open air the better. Regular exercise must be provided for all parts of the body—walking, tennis, cycling, gymnastics, cricket, or golfing—and the morning after-tub exercises and deep breathing must not be forgotten. The important point is that the exercises be regular, and not taken by fits and starts. Many a man would be in better health if he regularly walked rather than rode to his daily occupation.

Diet. At this period growth has not to be provided for, and therefore the diet, although abundant, will not require to be supplemented by extra allowances of proteid and fat. Stimulants in the form of alcohol are not required, and are likely to be more harmful than beneficial. Smoking in moderation—e.g. a pipe or cigar three times a day after meals—does no harm, but in excess, especially when the smoke is inhaled, it is liable to set up nicotine poisoning, evidenced by palpitation of the heart, muscular tremors, and troubles of sight. Smoking on an empty stomach is most injurious. The bowels must be kept regular without dependence upon medicines: a glass of hot water on rising or on going to bed will often suffice, and has the additional advantage of washing out the kidneys, while fruit, porridge, and brown bread will often assist matters.

Holidays. To anyone in active, strenuous work an annual holiday is a necessity. Change of scene, diet, thought, and occupation should be sought after, and will tend not only to keep men or women young and fresh, but also to send them back invigorated to their daily routine.

MIDDLE LIFE

Is arrived at insensibly and gradually, and if a man has carried out in his earlier life, and is still carrying out, the commonsense principles inculcated in these pages, there is no necessity to enter into minute detail. What a man sows, that he reaps, is a truth that needs frequent reiteration to-day.

As the years run on, "moderation in all things" must be the key-note—especially in food and drink. The elasticity of the tissues is less than in early adult age, and any excess, whether in violent exercise, eating, or brain work, is apt to have disastrous results. The intake of food must be regulated by the output of energy, and as the latter diminishes, so must the former. The excretory organs must be kept well at work; plenty of pure water between meals and at night and morning —the latter dose consisting of a mild saline aperient if needful—will help to rid the tissues of poisonous products, so much more readily deposited when the vigour and intensity of youth are passed.

Exercise must be persevered in, especially in the form of walking, which gives golf its unique place as the sport *par excellence* for middle life.

The teeth must be very carefully attended to, or indigestion and chronic discomforts are sure to arise.

A frequent mistake of this period is for a man who has neglected exercise for eleven months to start suddenly on a cycling or mountaineering tour. His tissues cannot respond to the sudden call upon them, and disaster follows. A sudden run to catch a train resulting in death is a common example of the same truth. If people would take the trouble to go on regularly with the training of their muscles mentioned under Early Adult Life, simply lessening the amount as time goes on, they would be in fit training for an enjoyable holiday of cycling or mountaineering taken in moderation.

The body weight in this period must be regulated. It should only be allowed slightly to exceed the normal, and a tendency to obesity should be taken in hand at once by reducing carbohydrates in the food and any malt liquor, and gradually increasing the exercise taken. The weight should not, however, be allowed to fall much below the normal, and medical advice should be obtained if it persistently drops.

OLD AGE

As middle age merges into old age, it is all important to keep up an active interest in the young, their pursuits and interests, and also in current events of the day, by both reading and conversation. This postpones the signs of the period, and really prolongs life.

Generally speaking, it is extremely rare for a person to die of old age; one organ or structure usually starts life weaker than another, and it may prematurely fail in advancing years. If "strict moderation"

was the motto for middle age, it must now be exercised in the superlative degree.

If old age will " recognise its limitations," it can be a healthy and happy period, but the *ego* must be no more its centre than it should be the centre of childhood.

In many respects the life of the old should approximate to that of the little child—light, easily digested food in small quantities at regular intervals ; long hours of sleep or at least rest in bed, for sleep is coy with the aged ; a good rest in the middle of the day, regular gentle exercise, light warm clothing, and a daily evacuation—all these points should be attended to. Many an aged person has been prematurely hurried into the grave by over stimulation with strong meat extracts and wines.

If from any cause the aged have to be confined to bed, care must be taken that the position is frequently changed, and that they sit up at intervals, otherwise the blood stagnates at the bases of the lungs, and this condition gradually spreads and eventually causes death.

CHAPTER LXXVII

THE HYGIENE OF THE SKIN, HAIR, AND NAILS

The Skin : Its Layers—Excretion—Blood Supply of the Skin—Cleanliness—Soaps—Baths—Hard and Soft Water—Cold Baths—Shock and Reaction—Hot Baths—Their Restorative and Sedative Effects—Vapour Baths—The Skin and the General Health—Emollients. The Hair : The Process of Growth—Chemical Composition—A Bad Conductor of Heat—Keeping the Hair Clean—Hair Dressings—Hair and the General Health. The Nails : How they Convey Disease Germs—How to Trim Them.

THE structure and functions of the skin have already been considered and illustrated (Vol. II., p. 1). It is however, permissible that a few details should be given here concerning the structural and physiological aspect of the skin and its appendages. We have to bear in mind that the skin is, structurally, a much more complicated tissue than is usually supposed. The anatomist divides it into several layers, of which the two chief are represented by the upper skin or epidermis, destitute of nerves and blood vessels, and the lower skin or derma, which shows a different structure possessing both blood vessels and nerves.

The Scarf Skin.

The upper skin, often known as "scarf" skin, may in its way be regarded as a layer which is perpetually being renewed by the under skin. The upper skin, in fact, consists of different layers of those microscopic units of our bodies which we term "cells." The lower layers of these cells, produced by the under skin, are typical in the sense that they are living structures. As, however, new cells are produced below them they are gradually pushed upwards, becoming thinner and drier in the process, until they assume at the outer surface of the upper skin a scale-like form and aspect. These upper cells are perpetually being given off from the surface of the skin. They are worn away by the friction of our clothes, and are removed in large quantities by the act of washing. The upper skin is therefore a layer which

is perpetually being renewed, and whilst we speak, in the case of the lower animals, of the process of moulting occurring periodically in their history, it is correct to say that in the case of man, in so far as his upper skin is concerned, it is perpetually going on. These epidermal skin cells, it should be noted, represent in themselves dead material in that, once living, they have died, and are cast off from the body as useless items, their place being taken, as we have seen, by the fresh growth of cells which is perpetually taking place from the upper surface of the under skin.

An important point is to be noted here. All kinds of dead material given forth from the body, and termed by sanitarians "organic matter," are to be regarded as constituting under certain circumstances a danger to health if allowed to accumulate to any extent, either on the body itself or in the air around it. The cause of the stuffy smell of an ill-ventilated bedroom, for example, is not the presence in the atmosphere of the carbonic acid gas breathed out from the lungs and representing part of the waste matters of our bodies. It is really due to the presence of organic matter which has been exhaled in part from the lungs and in part from the skin. Sanitarians teach with no uncertain voice that the presence of this organic matter in the air, when it attains a full measure of development, as in dirty, ill-ventilated, and overcrowded places, forms an aërial soil in which the germs of typhus fever breed and multiply. This disorder is the "jail fever" of olden days, a disorder which attained to unenviable notoriety when jails represented the acme of every filthy condition and were decimated from time to time by epidemics of typhus.

Having regard to the fact that the skin surface is perpetually parting with its worn-out cells, we become aware of another phase of personal hygiene in connection with the cleanliness of the clothing we wear. It may, indeed, be said that the necessity for regularly changing our underclothing, and for the maintenance in this respect of personal cleanliness, is due not so much to the presence in the underclothing of the products of the perspiration itself, as to the accumulation thereon of the worn-out cells of the upper skin. The value of baths, in addition to their promoting skin action, consists in their cleansing the skin from the effete organic material which is perpetually being given off.

No account of the skin, regarded from the hygienic standpoint, can be complete without a reference to the general functions which

this outer tissue of our body is known to perform. The skin is very much more than a covering to more delicate parts lying beneath. Leaving out of consideration for the moment the fact that the ends of the nerves of touch are to be found in its under layer—so that we really touch objects through the outer skin itself—we have to reckon with the skin as an organ of excretion. By this latter term is meant the conveyance of waste material from the blood, and naturally from the body itself. This bodily waste is the product of our bodily labour, for the body is to be regarded as a machine which, whether waking or sleeping, is constantly at work. Although its labours in sleep are certainly slowed down, nevertheless many processes, among them the work of certain brain cells, the secretion of bile by the liver, the circulation of blood by the heart, and the exchange of gases in breathing, are continued during our hours of repose. All work implies waste, and in the case of the human body the chief forms of waste are represented by heat, water, carbonic acid gas, mineral matters, organic matter, and other substances. The organs engaged in the elimination from the blood of waste matters are the lungs, kidneys, and skin; while we may add the liver as a fourth organ concerned in this process, seeing that it removes from the blood certain products which, however (in the shape of bile), are made use of in the process of digestion. The skin is therefore intimately associated with the lungs and kidneys. These three organs, in fact, might be termed a physiological trio, seeing that not merely do they eliminate from the blood its waste matter, although in different proportions, but their action is also to a certain extent closely related. Thus increased exercise, which causes a freer play of the lungs, has the effect also of stimulating the skin and increasing its work in getting rid of waste matter. So also we find that through increased action of the skin the duties of the kidneys are somewhat lessened, and physicians take advantage of this latter fact, because in cases where it is necessary to relieve the kidneys of some of their work, the skin is made to act more vigorously. The importance of the skin as a channel through which waste matter is eliminated is also brought to mind by the familiar fact that in the course of certain diseases—notably some fevers—the turning point of the illness, so to speak, is indicated by the occurrence of profuse perspiration.

Excretion.

The skin derives its great importance, in both health and disease,

from the fact that a very large quantity of blood is perpetually circulating through the network of fine blood vessels which is everywhere present in its structure. A very large amount of blood is thus being perpetually brought near to the surface of the body, and it is from this blood circulation in the skin that the sweat glands which open on the skin surface remove waste materials, passing them in the shape of perspiration to the exterior of the body.

Blood Supply of the Skin.

Incidentally, also, we can understand how the skin acts as a means for regulating the temperature of the body itself. It is of importance to note this fact in connection with the action of baths on the skin. The temperature or heat of the body is regulated by certain nerve centres which act through their control of the fine network of blood vessels that forms so conspicuous an element of the under skin's structure. By diminution of the calibre of these blood vessels less blood is circulated in the skin, whereas, by expansion of the blood vessels an additional quantity of blood is permitted to circulate. In this way, by lessening the action of the sweat glands or, on the other hand, by increasing that action, the temperature of the body is controlled. The perspiration poured out on the skin surface undergoes evaporation, and the body in this sense is cooled, and its heat maintained at a normal degree. Any conditions affecting the supply of blood to the skin, and the consequent excretion and evaporation of the sweat, will necessarily tend to raise the temperature of the body, and to produce, for example, a state characterised by dryness of the skin, typically seen in all cases of fever. The variations in the blood supply of the skin are also illustrated in a temporary phase by blushing. What happens to the body at large in the case of variations in the skin circulation is seen locally in connection with blushing, and also with the opposite condition, that of the production of pallor of the face. Through mental emotion the blood vessels, of the face particularly, are made to expand, a larger quantity of blood is circulated through them, and the skin surface is accordingly reddened. In the opposite state of pallor, constriction of the blood vessels takes place, less blood flows through the skin structures, and the functions of the sweat glands are proportionately interfered with.

The skin, so far, appears before us in the light of a structure discharging at least three important functions. It first serves as a body covering;

in the second place it is an organ of sense—that of touch; and in the third place we have seen it discharge the duty of a regulator of the body temperature. To these functions is added that by which, in conjunction with the kidneys and lungs, it serves as an organ of excretion, ridding the blood of part of that bodily waste which we know to be inseparable from the continuance of bodily work. In a certain sense, the relationship of the skin to the lungs is somewhat closer than might be supposed, in that the skin is known to absorb a certain amount of oxygen, just as by the lungs we inhale that gas with the air we breathe. This is a further indication of the high importance of maintaining the skin in a healthy state, and so enabling it perfectly to discharge the functions it performs in the human economy.

Cleanliness.

The care of the skin practically resolves itself into the maintenance of a cleanly state of this outer tissue of our bodies, and ensuring that its functions in the removal of waste are adequately performed. In health the skin may be said to form a layer which directly protects the body against the inroads of microbes or germs of disease, while the slightest scratch or abrasion of it may give opportunity of entrance to such germs. Not a few of the diseases to which the skin is subject, many of them of serious and intractable nature, are due to neglect of the skin in respect of maintaining a proper degree of cleanliness.

Soaps.

Soap has been described as our greatest civiliser, and whether the expression be regarded as true or not, it is in the most civilised peoples of the world that the practice of skin-cleansing is most thoroughly carried out. Soap consists of an alkali, either soda or potash, combined with some form of oil or fat. The latter ingredient may be obtained from the animal world, in the shape of the fat of the ox or sheep, or from the vegetable world, in the shape of certain oils. Thus in the finer soaps made to-day vegetable oils alone are found, and cocoanut oil is especially used for soap intended for use on board ship, this particular soap making a lather with salt water. Ordinary soaps are made with soda, which represents the alkali portion of the soap, but potash is also used in the making of soft soaps, whilst it forms an ingredient in certain shaving soaps. The action of potash is of a cruder character, so to speak, than that of soda, and it is therefore more apt to cause irritation of the skin. In the modern manufacture of soaps, certain varieties are known as super-

fatted soaps. In such products an additional quantity of fat or oil is added to render the soap more emollient and less irritating.

How soap acts in removing dirt from the skin is a matter which has received various explanations. Perhaps the most adequate one is that which regards the dirt to be removed as composed of matter united with the perspiration and the natural oil given off from certain skin glands, the oily secretion of the skin being destined to render it more supple. When soap is used, by being moistened with water it parts with so much of the soda it contains, this soda uniting with and removing from the skin the oily matter with which the dirt is combined. In fact, this process might be described as one in which a kind of secondary soap is formed through the contact of the skin oil with the soda given off from the soap, the union of the alkali with the skin oil dissolving the latter, with its contained dirt particles, from off the skin surface.

Baths.

The records of civilisation teach us that at a very early period of human history the necessity for skin ablution was fully recognised, and arrangements were made accordingly for the enjoyment of baths and bathing. A very perfect system of baths was extant amongst the Greeks and Romans, the Romans especially appreciating the advantages of an abundant supply of wholesome water, as evinced by the remains of the aqueducts which brought water into the city by the Tiber.

Hard and Soft Water.

The quality of the water used for application to the skin forms a point of some importance. The common division of water into hard and soft is a sufficiently correct one for ordinary use. Soft water is that in which no mineral matter is found dissolved; whereas the hardness of water will depend on the amount of minerals suspended in it, these matters being most frequently represented by sulphate of lime and carbonate of lime or chalk. The presence of chalk gives to water a quality known as temporary hardness, seeing that by boiling the water the chalk is deposited on the inside of the vessel and the water is thus softened. On the other hand, where sulphate of lime is the prevailing mineral in water, the hardness is termed permanent and cannot be removed by boiling, chemical means having to be used for its reduction.

The most suitable water for application to the skin is undoubtedly soft water, represented by rain water and distilled water, but there is no objection to the use of water of a moderate degree of hardness. The

objection to very hard water is, firstly, that it is difficult to procure a lather with soap ; and secondly, that the action on the skin of the minerals it contains is to a certain extent prejudicial, and frequently gives rise to a hard and dry condition of the cuticle. In connection with baths, the effect of sea water has to be taken into account. Leaving any question of cleansing out of sight, salt water has a stimulating effect on the skin, produced by the adherence to it of the salt particles. This, on the whole, may be regarded as an excellent tonic measure when applied to a healthy skin surface, but where any delicacy of skin exists, salt water bathing is apt to cause irritation.

Can the Skin Absorb Water?

An interesting question in connection with the skin is whether or not it possesses any definite powers of absorption. In former days it was supposed that the skin could absorb water, and the fact that shipwrecked sailors, whose water supply had run short, assuaged the pangs of thirst by wrapping their bodies in clothes wrung out of sea water, appeared to lend support to the idea that thirst was lessened through the absorption of water by the skin. We now know that this was an erroneous supposition. The skin has no power of absorbing water, and the practice of the sailors is explicable on the ground that by applying clothes soaked in water to the skin, evaporation was lessened, and the loss of water from the system in this way decreased. The skin, however, can be made to absorb certain medicinal substances when these are applied to it in the form of ointments and rubbed into the surface, and physicians are accustomed in the treatment of certain diseases to employ this form of medication.

Seeing that the skin, therefore, possesses as regards water no absorptive powers, it is clear that the action of baths must be referred to the influence they exert upon the skin-surface itself, and upon the circulation of blood through the skin. Powerfully affecting as they do the skin circulation, they will exert a distinct effect upon the skin functions, and through these latter, in turn, influence the health of the body at large.

The use of cold water as applied to the skin is to be regarded in the light of a stimulating rather than of a cleansing measure. If we desire to rid the skin of its worn-out cells and of any products of excretion which may remain on its surface, we must employ hot water or hot vapour, and associate the action of the water with that

of soap. It has sometimes been remarked that the skin of persons who have indulged very little in bathing may exhibit a surprising degree of cleanliness. This fact has not escaped scientific notice, for we find one authority declaring that where a fair amount of exercise is taken, the friction between clothes and skin, and the fact of the perspiration perpetually being excreted from the sweat glands, are actions sufficient in themselves to produce a fair degree of skin cleansing. In such a case, however, we have to take into account the circumstance already noted—namely, that the *débris* shed by the skin in the shape of worn-out cells will be none the less offensive, seeing that it will be retained by the clothing. It has to be remembered that the sweat glands are perpetually active in all circumstances and under all conditions of life. There is no cessation of the excretion of perspiration on the skin surface. The ordinary state of the healthy skin is represented by a moist condition due to the giving forth of what physiologists term "insensible perspiration." When exercise is indulged in, and the amount of perspiration given forth is markedly increased, the excretion of sweat is described as "sensible perspiration."

Considering now the manner in which cold and hot water, applied to the skin, respectively act on the body at large, we may remind ourselves, in the first instance, that the natural temperature of the body stands at about 98·4° Fahrenheit, and the range of the temperature of baths may accordingly be calculated from both below and above this normal temperature of the body taken as a standard. The cold bath naturally varies in respect of its temperature according to the season of the year, and necessarily will be of a lower temperature if taken in the open than if enjoyed in a bathroom. As to baths which lead us towards the body temperature and beyond it, we first notice tepid baths, varying in the degree of heat from 85° to 95°. Next in order come warm baths, which may be said to range from 96° to 104°, while hot baths extend from 102° to 110°. Degrees of heat represented in baths over 110° ought not to be employed save under medical direction; even then such a degree of heat would only be used for a very limited time, and with some special end in view. It is well to bear in mind that water is a much better conductor of heat than air, so that whilst air of a temperature of say 75° to 76° would in no sense convey a feeling of cold, a similar temperature of water would constitute for most persons a bath on the cold side.

Cold Baths.

The action of cold water applied suddenly to the skin surface, as in the case of a cold bath, is to produce a momentary feeling of what is termed "shock." The immediate effect of the application of the cold is to cause an instantaneous contraction of the minute blood vessels or capillaries of the skin, with the result that a large portion of the blood normally circulating through the skin tissues is driven to the inward parts of the body. In ordinary circumstances, this passage of the blood from the surface inwards is followed by what may be called a natural recoil, and the blood, after receiving from the internal parts an increased degree of heat, returns immediately to the surface of the body, the blood vessels expanding to receive it under the influence of the nervous system. In this way we can account for the feeling which a healthy man experiences on plunging into cold water, and also for the feeling of warmth and glow which is due to the return of blood to the skin surface. When this reaction has succeeded the preliminary chill, the end to be attained by the bath has been accomplished. Further exposure to the influence of the cold water will only tend to the production of a more or less prolonged condition of shock, which is bound to give rise to chill, a condition capable on occasion of producing disastrous effects on the various systems of the body. Whilst the cold bath exercises an invigorating effect upon a healthy person, it may have an injurious effect in the case of a person of weakly constitution. Either the reaction is imperfectly established, a feeling of chill being the result, or serious effects may be induced by the sudden diversion of blood to internal parts. The cold bath is thus emphatically only to be recommended to those who are robust, a remark which applies with special force to cold bathing in the open air.

The cold bath produces an invigorating effect by its stimulation of the circulation through the skin, and by generally increasing the force of the circulation in all parts of the body. The skin is more thoroughly flushed through the increased activity of the heart and blood vessels. For persons who are not over robust, a substitute for the cold bath is found in the application of a wet towel or wet sheet. A bath towel, wrung out of cold water and applied vigorously to the body in the bedroom, followed by brisk friction with a dry towel, may be used. Or the temperature of the water may be raised to say 80° or 90°. The latter temperature is very suitable for cold weather; in summer most

persons who are capable of enjoying a cold bath at all may use the water at its natural degree of heat.

Hot Baths.

Turning now to the hot bath, we find this measure associated with the cleansing of the skin by the aid of soap, but, when taken simply as a bath, we discover its effect to be in some degree comparable to that of the cold bath. The hot bath, like the cold, accelerates the circulation of the blood through the skin and through the body at large: hence its usefulness when applied after chill by way of neutralising the contraction of the skin blood vessels, and inducing a flow of heat to the chilled surfaces. It not only increases the circulation through the skin, but also acts as a stimulant to the heart and blood vessels without the intervention of the preliminary shock sustained in cold-water bathing. We find in these facts an explanation of the remarkable restorative effects which a warm bath exerts in the case of a tired and weary person. The body, having been overworked, so to speak, is unable to react after the application of cold water, whereas hot water produces its stimulation in a gentle and effective fashion, without the production of any antecedent shock.

Yet another phase of the hot bath has to be taken into account in its soothing or sedative action. Many persons, on taking a hot bath, experience, if they remain long enough in the water, a feeling of comfort deepening into a certain degree of languor. This sedative action is due to the fact that all the functions of the body, more especially those of the heart and blood vessels, are so influenced that less blood is sent to the brain than at other times. Hence arises the sleepy feeling that is induced, and the utility of the hot bath at night in cases of sleeplessness is thus demonstrated. Persons who suffer from any weakness of the heart should, however, be as careful in the use of the hot bath as in the use of the cold.

Vapour baths are of various kinds, ranging from elaborate Turkish and Russian baths to simple expedients in the shape of portable vapour baths. In the latter case the bather is enclosed within the bath cabinet, and hot air is produced through the medium of a spirit lamp or similar appliance placed below the chair on which he sits. The effect of vapour baths is to stimulate the action of the skin in a far more decisive fashion than is the case with ordinary hot baths. The skin glands are made to act more quickly and more effectively, and if, as in the case of Turkish baths, there are also employed processes allied to massage, whereby the

skin and muscles are rubbed, kneaded, and shampooed, the effect not merely on the skin itself but on the whole system is largely increased. The work of the bodily organs is quickened, and when a gradual process of cooling down has been supplemented by the cold douche or plunge, a general feeling of well-being is established. The danger of taking cold after indulging in warm baths, more especially if any exposure has to be faced, may be obviated by the application of the cold douche, which, cooling the skin swiftly, produces no injurious effects by the reaction which we have seen to follow the application of cold water.

We may here note that, by persons for whom cold bathing is suitable, no danger of taking chill is incurred by entering water when the body is heated, always provided that the bather does not stay too long in the cold water, and employs brisk friction on emerging therefrom. The condition which is apt, beyond all others, to induce chill is that of entering the water when the body is cooling, and when, therefore, the frame is in a somewhat depressed condition.

The cleansing action of soap in connection with hot baths may be assisted, and the pleasure to be got from the bath increased, by the use of a flesh brush, capable of applying a certain amount of friction to the skin surface. Many persons, too, experience good effects from adding to the bath a small quantity of ammonia. Even at home, both hot and cold baths may be rendered more enjoyable and more stimulating on occasion by the addition of a handful or two of sea salt.

Certain other points connected with the health and care of the skin demand attention. The skin not merely acutely sympathises with the general health of the body, but in its turn influences the bodily health in a very marked degree, as, for example, when a chill affecting the surface of the body gives rise to colds and lung troubles. There is no known means of securing a skin free from blemish and imparting an attractive appearance, unless, indeed, it takes the form of the advice that a healthy skin must enclose a healthy body. The use of lotions, wash powders, and other extraneous "aids to beauty" is to be thoroughly deprecated. At the best such expedients can only serve to conceal skin defects, and skin troubles may indeed be made infinitely worse by the use of applications containing substances of an irritating nature. Where any

The Skin and the General Health.

roughness of the skin exists, the application of a little lanoline may be recommended; and where, as after shaving, the skin may show irritation, or where in consequence of exposure to chill the skin surface may be harsh, a simple lotion, made by adding 1 part of the tincture of benzoin to 10 or 15 parts of rose water, will be found serviceable. We must bear in mind that the skin acutely sympathises with every condition which affects the bodily health at large. The skin of the person who suffers from dyspepsia is apt to be dry, harsh, and sallow; and it may also be noted that where constipation exists the skin surface becomes affected by the process of self poisoning which results from the retention in the body of digestive *débris* which are meant to be expelled. Wherever skin conditions exist which appear to call for local treatment, it may be assumed that some disorder of the integument itself is present; but where, on the other hand, a general alteration of the skin surface has to be dealt with, we may then legitimately suspect that the fault lies not so much with the skin as with the general health, the condition of which should be thoroughly inquired into, and any defects that may be discovered duly corrected.

Emollients.

If we attempt the task of classifying the various structures of the body according to their true nature and their origin or mode of development, we should group together in a natural fashion teeth, nails, and hairs; and if we direct our attention to lower forms of animal life, the feathers of birds would be included in the same list. All these organs are, in fact, skin structures. The teeth are formed in that layer of the skin which, folded inwards at the mouth, becomes the gums. Hairs are formed in the deeper skin layer, and nails differ from hairs only in the manner in which the horny matter is produced from the nail matrix, which represents a portion of the under skin situated at the ends of the fingers and toes.

Hair.

Each hair arises from a kind of funnel-shaped involution of the skin known as the hair sac, which has been figured in an earlier volume. At the bottom of this sac is found a depression, into which we find a small projection fitting, the projection being known as a papilla. The lining of this hair sac is really formed of the same cells which we have seen to constitute the bulk of the substance of the outer skin. The sac itself may be found either in the

The Hair Sac.

under skin, or as a microscopic section of the skin shows, it may extend into the layer beneath the outer skin, and thus come to impinge upon the stratum of fat on which the skin rests.

The Papilla.

The papilla or little projection of the hair sac resembles very closely in its nature a similar projection found in connection with the development of the teeth. The papilla in each case is, in fact, a mould on which tooth and hair alike are formed, the only real difference being that the substance of the tooth consists of mineral matter, whereas that of the hair consists of horny matter specially arranged so as to grow and develop in the form of the well-known fibre. Delicate cells exist in the papilla, the blood vessels of the projection supplying the material wherewith these cells are nourished, and the development of a hair may be really regarded as a process in which the horny elements formed on the papilla are gradually combined and pushed by fresh groups of cells from below outwards from the hair sac, to assume the definite shape of the hair itself. The hair root lies in the little sac, and shows a swelling at its lowest portion, known as the bulb. The under surface of this bulb is cup-shaped, and fits, as we have seen, on to the papilla itself.

The Shaft.

The shaft of the hair is the portion that projects from the skin. The substance of the shaft is composed of cells of a horny nature, these cells being bound together by a kind of substance comparable in its nature to cement. In this cement we find grains of pigment or colouring matter, and bubbles of air. In hairs of an extremely dark colour the pigment appears to be better distributed than in those of a lighter colour, and colouring matter can be detected in the hair cells. The cells in the central part of the hair appear to be of a more active character and of a more vital nature than those in its outer part.

Microscopically viewed, a hair is therefore seen to be a solid substance, and not, as many people suppose it to be, a tube. Connected with hairs we find certain glands, called sebaceous glands. They produce a fatty or oily material, which tends to render the skin itself supple, and which no doubt supplies some form of nutriment to the hair; or the secretion may serve to lubricate the hair and thus to favour its easy growth and passage from the follicle to the surface.

The chemical composition of hair reveals certain interesting facts.

Thus an appreciable amount of sulphur is found, and red hair reveals on analysis traces of iron, with the addition of an oily secretion of reddish tint. In white hair other chemical compounds —notably phosphate of magnesia—are found, whilst it is said that in the hair of aged people phosphate of lime is developed. The number of hairs in the head has been variously estimated. Thus it has been calculated that in a square inch of the scalp 600 hairs are contained in dark persons, to 700 in persons of blonde complexion. If, as according to one estimate, 120 square inches may be allowed to the average head, we get a total of 80,000 hairs; but as two hairs are found frequently to grow out of one follicle, the actual number is probably much greater.

Chemical Composition of Hair.

It is somewhat difficult to account for the fact that man's hairy covering is, so to speak, broken up into certain areas on his body, leaving the general surface more sparsely covered. In all probability the distribution of the hair in man has followed certain laws of evolution, the discussion of which is foreign to a work of this kind. Readers interested in the subject will find in the works of Darwin and other evolutionists interesting theories regarding the causes which have led to the peculiar characteristics of human hair development.

Being a bad conductor of heat, hair serves to maintain the warmth of the part to which it is attached. In this way it must exercise a certain effect in maintaining the normal temperature of the body. In the eyelashes we have a species of fringe, which tends to protect the eyes from dust. There can be little doubt also that a moustache acts as a kind of respirator in arresting dust particles; whilst hairs found in the ear passage will naturally tend to prevent the entrance of insects, and may also help to prevent the entrance of dust.

A Bad Conductor of Heat.

An old saying—but a true one—has it that "where there is hair there is dirt." The great point in the management of the hair is to maintain, as far as possible, a high degree of cleanliness. It does not follow, however, that the hair demands as frequent washing and cleansing as the skin. No fact is better established than that which teaches us that too frequent washing of the head, or even wetting of the head, is a cause of the prevailing baldness among men. The effect of wetting the head daily, for example, appears to be to dry up the natural fatty secretion

Keeping the Hair Clean.

of the oil glands of the skin, and to induce a condition of the scalp which causes hair weakness, and favours the partial or total loss of hair. The hair should be washed once every ten days or so, a pure soap being used for this purpose, or any simple shampooing fluid.

In most cases, it will be found advantageous to keep the hair moderately short—that is, in the male sex. In women, whose locks are more abundant as a rule, and necessarily longer, the same rule of washing the head applies, and their hair should be regularly brushed night and morning. The brushes used by both sexes should be soft, and the use of small combs should be avoided. Where scurfiness is present in the hair, it is made worse by the use of hard hair-brushes and of combs which, by detaching some of the loose skin scales, accentuate the condition.

Hair Dressings.

The question frequently arises whether or not the healthy hair requires any form of dressing. The reply to this inquiry must be a relative one, inasmuch as the quality of hair varies materially in different persons, and in those whose hair is abundantly supplied with oily matter, little or nothing in the way of dressing is required. On the other hand, in certain varieties of hair—especially those of a dry nature, and where hair weakness tends to be developed—the use of some simple application to the scalp each morning, with moderate brushing, may be found to be effective in correcting such hair troubles. There is no lack of hair dressings, ranging from simple olive oil with a few drops of some concentrated scent essence added, to more elaborate preparations composed of various oils to which a little spirits is added. These last are extremely useful and cleanly as hair dressings, but any excess of spirits in such preparations should be avoided, because the action of spirits tends to dry the hair and to cause it to develop extreme brittleness. An excellent preparation for the hair is the following :—

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Castor oil	4 drachms.
Almond oil	28 drachms.
Glycerine	12 drachms.
Rectified spirits	4 drachms.
Perfume	8 drachms.
Tincture of cantharides	1 drachm.

This preparation has the advantage of being a simple hair dressing and tending to favour luxuriant hair growth. If it is found

to be too oily, the quantities of the oily ingredients can be easily reduced.

Hair and the General Health.

The hair, like the skin, sympathises with the general health of the body, and it is characteristic of certain diseases that they may be followed by more or less extensive loss of hair. In such cases the cure of the constitutional disease for the most part results in the renewal of hair growth. In other cases definite disease affecting the hairs themselves may be productive of baldness, and a general weakly condition of the hair may frequently be found without any obvious cause. Remedies for baldness have already been given (Vol. II., p. 35).

The Nails.

Nails, as we have seen, are skin-structures—that is to say, they are developed from a special skin-layer, just as hairs and teeth are produced. The matrix of the nail is the name given to the modified portion of the skin whose duty it is to develop the horny matter, which is gradually pushed forwards so as to cover the upper surface of the finger or toe. In about four months' time a finger-nail appears to reproduce its own length.

Nails by their condition reflect certain phases of the general health of the body. Thus a curved form of the nails is often found associated with long-standing cases of heart disease, a result due to interference with the free circulation of blood at the finger-tips, while the same remark applies in connection with certain lung troubles, notably in that disease in which there is undue dilatation of the air cells of the lungs, an affection known as bronchiectasis. In cases of gout, and also in the skin troubles known as eczema and psoriasis, the nails are apt to develop a ribbed condition, and to split easily.

The care of the nails is a matter which should receive attention, not merely from the æsthetic point of view, which has regard to their appearance, but still more from the standpoint of hygiene, in which the duty of maintaining their cleanliness becomes of importance. The close relationship of the nails to the food we eat, and to the mouth, demonstrates the possibility of disease being conveyed by dirty nails, while it may be mentioned as a fact of interest in this connection that in cases of worm trouble, reinfection has occurred by the mouth when the cleanliness of the nails has not been scrupulously attended to. They should be regularly brushed and trimmed. It is a great mistake to cut the skin at the roots of the nails if it becomes redundant and

overgrown. The result of cutting this skin is to increase its growth unduly, and so to render more annoying the original condition. The skin should be simply pressed back day by day, after it has been softened with warm water. Similarly the process of nail-cutting should be performed with care. Regular trimming of the nails is far preferable to allowing them to grow long, and then cutting them. If a tendency exists for the skin at the sides of a nail to overgrow excessively, the nail may be trimmed to a greater extent in the centre than at the sides, thus favouring increased growth towards its middle part and lessened growth at the sides. Where, as in the case of in-growing toenail affecting the big toe, pain and inflammation exist, special means (described in another section of this work) must be adopted to cure this troublesome affection.

CHAPTER LXXVIII

THE HYGIENE OF THE MOUTH AND TEETH

The Saliva—Connection between the Mouth and the Inner Parts of the Ear—Microbes in the Mouth—To Prevent Inflammation—A Word to Smokers—Bad Breath—The Teeth, and how to Take Care of them.

THE hygiene of the mouth and teeth has of late years attracted a great deal of attention. The importance of the subject arises from the fact that the mouth is the vestibule or gateway of the body. It is a cavity that has relations both to the external world and to the organs to which it stands in the position of an ante-chamber. It is necessary first to glance briefly at the anatomical relations presented by the mouth, and more especially those which concern the various passages that open from this vestibule to the body.

In the first place, the mouth serves as an ante-chamber to the digestive system, and also to he organs of respiration. It is lined throughout with a delicate mucous membrane, embedded in which are glands supplying the natural mucous secretion which lubricates all the parts of the cavity.

Connected with the mouth by tubes are the salivary glands, which secrete the saliva or water of the mouth, a fluid elsewhere described as playing an important part in the digestion of food; for it is through the action of a ferment called "ptyalin," contained in the saliva, that the starchy foods we consume are converted into sugar, in which latter form it is intended they should pass to the stomach. The saliva is therefore poured into the mouth more or less constantly, an increased flow taking place when food is received. In this way the mouth is kept moist and articulation rendered easy.

The Saliva.

The tongue occupies a prominent position in the mouth, not merely serving as a mechanical apparatus concerned with the gathering of food particles together and the swallowing of food, but also discharging the functions of an organ of taste, a duty which it shares with the nerves of the palate.

Opening from the back of the mouth, and passing upwards into the ear parts, we find on each side a tube known as the Eustachian tube.

Eustachian Tubes.

These tubes serve to maintain an equality of air pressure between the air pressing on the drum of the ear from without, and that pressing on it from within. It is important to recognise the Eustachian tubes, seeing that in certain mouth conditions germs or microbes are liable to pass from the mouth through the tubes and to gain access to the inner parts of the ear, there giving rise to various ear diseases, amongst which suppuration of the middle ear is probably most common. This result is common in cases of measles, scarlet fever, and diphtheria, and forms a very annoying complication of those maladies.

Situated at the back part of the mouth on each side we find a tonsil. These organs are classified among the ductless glands of the body—that is to say, organs from which no tube or duct issues forth. In addition to secreting mucus for the lubrication of the throat, and so assisting in the act of swallowing, it is not improbable that the tonsils assist in the manufacture of white blood corpuscles or phagocytes, which discharge the duty of attacking and devouring foreign particles—including microbes—that find their way into the mouth cavity. The throat or gullet opens from the back part of the mouth, and passes down the front of the spine on its way to the stomach. In the front of the gullet lies the windpipe or trachea, which is the pathway to the lungs. At the top of the windpipe is situated the larynx, or organ of voice, sound being produced by the upward rush of air from the lungs setting in vibration certain folds of membrane in the voice-box known as "vocal cords."

This general sketch of the mouth parts will enable us to appreciate the importance of attending to what may be called the hygiene or

Microbes in the Mouth.

"toilet" of the mouth in connection with the preservation of personal health. To begin with, we must note that the mouth may in one sense be described as a veritable hothouse, and as such presents conditions that are well adapted for the invasion by and development of various species of germs. The temperature of the mouth, in fact, is that of the blood—namely, about 98·4° F. As everyone knows, the temperature of the body is taken in an ordinary way by placing the bulb of the clinical thermometer under the tongue and closing the lips upon it. In addition

to the presence of a high temperature in the mouth, we have also to reckon with the condition of constant moisture in which the mouth is kept. Now heat and moisture together are ideal conditions for microbic growth. Hence arises the importance of careful attention to the mouth as a means for the preservation of health. Considering that much of the air we breathe and all the food we eat have to traverse the mouth before reaching the lungs and stomach respectively, it is obvious that any conditions in this cavity which may be regarded as abnormal or unhealthy must exercise a deleterious effect on the health of the body at large.

We must be careful to note that of the microbes which are inhaled or swallowed a large proportion are harmless. Indeed, scientific research has demonstrated that we have a natural microbic population of the mouth consisting of germs which, so far as is known, exercise no deleterious influence whatever either on the mouth itself or on the teeth. But, on the other hand, there are also germs which are certainly of a pathogenic, or disease-producing, nature. When we consider that a large number of infectious diseases are liable to be conveyed in the air we breathe, in the food we eat, and in the water we drink, there can be little fear of exaggerating the importance of the part played by the mouth as the ante-chamber of the body at large. The mouth being thus extremely liable to harbour infective microbes, giving rise not merely to local diseases affecting the mouth itself but also to general diseases of the body, too much care cannot be bestowed upon this cavity in order to maintain it in a healthy condition.

The use of mouth washes and of like simple remedies is indicated wherever conditions present themselves of the kind to which the term "septic," is applied. By this term is indicated any substance or principle that gives rise to a poisonous action on the body, either locally or generally, the opposite condition being that to which the term "aseptic" is applied. The chief matter to be attended to in respect of the hygiene of the mouth is, therefore, to maintain it in an aseptic condition. Although it may not be possible to keep the cavity perfectly aseptic, by rigid cleanliness a considerable amount of local disease connected with the mouth parts may be prevented.

Wherever any condition appears in the mouth in which inflammation plays a part, the need for extreme care and attention becomes at once evident. Inflammation is extremely liable to affect the tonsils, for

example, giving rise to tonsillitis or quinsy. There are, however, other conditions affecting this cavity which may be said to represent unhealthy states, derived from the teeth, and also from general disorders affecting the lining membrane of the mouth. Where any condition of the kind indicated exists, the mouth should be gargled with some simple antiseptic mouth wash. A simple means of disinfecting the mouth and throat is the following :—

To Prevent Inflammation.

PRESCRIPTION 305

Borax	1 drachm.
Glycerine	2 ounces.

Another excellent preparation is—

PRESCRIPTION 306

Tincture of myrrh	3 drachms.
Alum	1 drachm.
Acid infusion of roses to 6 ounces.	

A little of either of these mouth washes may be used as often as desired.

Probably no drug is more useful in inflammatory conditions affecting the mouth than chlorate of potash. A tabloid consisting of chlorate of potash, cocaine, and borax, allowed to dissolve in the mouth occasionally, exercises a cleansing action on the parts. A substance which has recently been introduced into medicine under the name of formamint has also attained a high reputation in the maintenance of an aseptic condition of the mouth. It is used as tablets, one of which is allowed to dissolve in the mouth, the saliva bringing the remedy into contact with the mouth parts at large.

In the case of smokers it need hardly be said that there is special need for care in ensuring the maintenance of a healthy state of the mouth and gums, although the opinion has been frequently expressed that tobacco itself exercises a certain amount of disinfecting action, and may thus be regarded as in one sense inimical to the life of microbes.

A Word to Smokers.

A condition which gives rise frequently to a considerable amount of annoyance in connection with the mouth is that implied in the phrase "a disagreeable odour of the breath." This affection is annoying less to the subject thereof than to those around him. It may arise from various

causes. If any septic condition is present in the mouth itself arising from decayed teeth, a spongy condition of the gums, or the presence of local suppuration connected with the gums or other parts, the breath will naturally be tainted. Otherwise, the presence of digestive trouble may account for the disagreeable odour, this condition being a constant symptom in ordinary cases of dyspepsia or indigestion. As a remedy, the sweetening of the mouth by the means already suggested may be tried. But if the affection is due to digestive irregularity, this, of course, must be corrected on the lines laid down for the cure of dyspepsia at large. One remedy for bad breath which is found effective is the taking of a charcoal biscuit half an hour before or an hour after meals, the effect of the charcoal being to assist the cure of the special conditions to which the offensive breath is due. Where a spongy condition of the gums exists, chlorate of potash or formamint may be used as a remedy, provided the affection does not arise from any constitutional disease, of which scurvy is perhaps the most familiar example. It will, however, be found that in the vast majority of cases the state of the teeth has to be reckoned with in considering septic conditions affecting the mouth. Hence the importance of paying close attention to these organs.

Bad Breath.

The teeth are structures whose hardness is due to a substance composing the bulk of the tooth, and known as dentine or ivory, whilst the crown of the tooth is coated with a still harder substance, the hardest, in fact, in the body, known as enamel. Though teeth are apparently of a highly durable nature, they are extremely subject to the attacks of disease set up by the presence in the mouth of certain species of microbes. The most commonly received explanation of the process of tooth decay is that which credits acids generated in the mouth as the means whereby the enamel and dentine of the teeth are attacked and dissolved. These acids are the products of a species of fermentation liable to proceed in the mouth and favoured by the two conditions already noted: the heat of the cavity and the moisture it contains. After every meal we eat, particles of food are liable to remain in the interstices of the teeth; these particles, especially if they consist of starchy materials, undergo a process of fermentation, in which they are invaded by the species of microbe just mentioned, acids being as a consequence produced. This explanation is in conformity with all that is known of microbic action in the

The Teeth.

mouth. Hence the high importance of removing from the mouth the food *débris* which have collected during the day. It has been remarked that we ought to cleanse the mouth and teeth after every meal we eat, but the exigences of existence render this a difficult and in many cases impossible ideal. But at least we can ensure a large amount of safety for our teeth by rigidly observing the rule of brushing them and cleansing the mouth before we retire to rest. In this way the accumulation of food particles which has taken place during the day is disposed of, and the basis for germ action is removed. There can be little doubt that it is during the silent watches of the night that the process of fermentation is most active. The cleansing of the teeth at night may therefore be regarded as an essential condition of the preservation of these useful structures. The brushing of the teeth and the cleansing of the mouth in the morning are to be taken as a matter of course, but are really of less importance than the evening brushing and cleansing.

The teeth should not merely be brushed across, but should also be cleansed in the up-and-down direction as well; and where there may be difficulty in removing from their interstices food particles, a fine thread may be passed between the teeth. If tartar collects on the teeth—this substance representing mineral matter derived from the food—they should be scaled by the dentist. It should be noted that tooth powder is the only effectual means of freeing the teeth from food *débris* and generally cleansing them. Liquid washes and pastes are of minor service in this respect. The number of tooth preparations offered to the public is, of course, legion; but some simple powder of the nature of camphorated chalk or magnesia, or carbolic tooth powder, will fulfil all the requirements of the case.

CHAPTER LXXIX

THE HYGIENE OF THE EAR

The Most Complicated Organ in the Body—Intimate Connection with the Brain—A Hint to Bathers—Toilet of the Ears—Removal of Wax—"Brain Deafness."

Without doubt, the ear may be described as the most complicated organ in the body. It is more complex in structure than the eye itself, and from its position, lodged as the internal parts are within the temporal bone of the head, the accurate investigation of his organ is a matter of extreme difficulty. The structure and functions of the ear parts have been described elsewhere in this work. It is necessary here, however, to note that the ear stands in very close relation to the brain, and diseases therefore which affect the ear are extremely liable in turn to influence the brain; so that no cases of ear trouble, however trifling, should be neglected. We have already pointed out that infection from the mouth and throat may be conveyed along the Eustachian tubes to the internal ear. Cases of what are called "running ears" in young children after measles and scarlet fever raise in this way, infection proceeding from the throat by way of the tubes, and affecting the internal ear parts. In course of time, when suppuration occurs, the matter bursts through the drum of the ear and is discharged from the outer ear opening. Neglected cases of this kind inevitably result in the destruction of the drum and the consequent loss of hearing, whilst another and greater danger exists in that the infective matter is liable to be absorbed and conveyed to the brain, setting up in that organ inflammation, which presents a singularly dangerous condition. If one piece of advice regarding the hygiene of the ear should be more boldly and emphatically given than another, it is that bad cases of discharging ears should be treated by a competent ear surgeon. All ordinary household remedies applied for this purpose are of no service whatever, and it is worse than cruel to allow a child so afflicted to continue to suffer,

for there is the risk not merely of rendering the child deaf but also of afflicting it with serious brain disease.

In connection with such ear troubles it is also advisable to bear in mind that bathing which involves the entrance of water into the ear openings should never be indulged in by persons with defective ear drums. Fatal cases of brain inflammation may in this way be set up, through water gaining admission to the internal ear parts. It is well, indeed, that all who bathe and swim should place cotton-wool in the ears. This more especially applies to persons who practise high diving. The sudden change of pressure which is represented in passing from the atmosphere to deep water is apt to exercise an injurious effect on the delicate drum of the ear, and may even cause rupture of that membrane.

A Hint to Bathers.

Great carelessness is frequently shown in what we may call the home treatment of the ears. Soap and water should never be allowed to gain access to the ear at all. The constant wetting of the drum of the ear in this way tends to give rise to earache and other affections, whilst it is possible to maintain all the cleanliness of the ear that is necessary without allowing soap and water to gain access to the cavity, whose surroundings are of such a delicate nature. Again, the ear is liable to suffer ill-treatment in cases in which an insect or any other foreign body gains access to the ear passage. The popular notion that direct communication exists between the ear and the brain is, of course, erroneous, for the ear passage is a *cul de sac* or blind alley, closed at its inner end by the drum. Hence, when any foreign body gains access to the ear, if extreme gentleness is not sufficient to get rid of it the services of a medical man should be at once requisitioned, for by means of a simple instrument he will be able to remove the intruder. If the blunt end of a hair-pin, cautiously used, is not sufficient to extract any foreign body, the case can perfectly well be left alone until medical aid is obtained.

It need hardly be said that the practice indulged in by many persons of attempting to remove waxy concretions from the ear passage by probing it with hard objects is a dangerous one, for the reason that the ear drum may be easily injured. Where wax exists in the ear the sufferer should, on going to bed at night, pour a little olive oil into the ear, plugging the opening with cotton-wool, so as to soften the wax, which can then

Removal of Wax.

be readily removed by judicious syringing. In syringing the ear passage tepid water should be used, the water being directed along the top of the passage, so that the back flow may sweep out and remove the wax.

Yet another caution may be given regarding the treatment of the ear. It has already been pointed out that in cases of discharges from the ear unskilled treatment is worse than useless. All tampering, therefore, with quack remedies, many of them consisting of substances apt to cause irritation of the ear drum, is to be condemned. Many contrivances exist at the present time for the relief of deafness, and even where the art of the surgeon fails to accomplish a cure, an instrument maker is capable of supplying means for the magnifying of sound, such as largely restore to the deaf the power of appreciating those surroundings of which it is the duty of the ear specially to take cognisance. If there is any branch of quackery more to be condemned than another, it is that which holds out specious promises to cure deafness by purely empirical and, as a rule, utterly useless practices. It is to be remembered that deafness is a condition due not to one cause alone but to many, ranging from affections of the drum to the solidification of the small bones or ear ossicles through the vibration of which sound is conveyed from the drum to the internal ear, and it is obvious that the most hopeless cases of deafness are those in which this latter process has taken place. Yet the ear quack will assure a patient suffering from this incurable condition that perfect success will attend his treatment.

A condition known as "brain blindness," due to interference not with the eye itself, but with the centres of the brain which receive impressions from the organ of sight, is paralleled by a state to which the term "brain deafness" may be applied. In considering our organs of sense, we have to take into account not merely the organ itself, which only receives sensations from the outer world and so transforms them that they can be appreciated and in their turn modified by the brain, but also the brain as the organ with which we really see, hear, feel, smell, and taste. It therefore follows that the brain must exercise a very distinct effect on the efficiency with which the ear discharges its important duties. Certain ear troubles, instead of arising in the ear, have their location in the brain, and in such cases it is even more necessary to have skilled advice than in those in which the ear itself is the seat of the mischief.

CHAPTER LXXX

THE HYGIENE OF THE EYE

Neglect at Birth—Poulticing the Eyes—Sight and the General Health—Neglect in Childhood—Abuse of Sight in Adult Life—Choice of Glasses—The Need for Sleep—Effect of Alcohol on the Sight—Effect of Excessive Smoking.

THE importance of preserving the eye from injury, from strain, and from the attack of actual disease, should be obvious to the least reflective. It happens to be an organ of sense which is extremely liable to suffer from the three causes just specified. Considering the importance of the eye and the delicacy of the various structures entering into its constitution, it is surprising to find on the part of the public an amazing carelessness in respect of this precious organ. Yet how much does even impairment of vision imply in the life of any human being, while the loss of this faculty is an overwhelming calamity. On all grounds, therefore, the care of the eye, even more than the care of the ear, is one of the most imperative of the duties which each of us owes to himself.

It has been ascertained that by far the larger proportion of cases of blindness are due to neglect of the eyes at birth. This is a point of extreme importance to mothers and nurses. In the course of labour the child's eyes are apt to be affected by the secretions of the mother. If these are unhealthy, a process of inflammation is set up in the eyes of the newborn child, with the result that if attention is not at once paid to the treatment of this condition, the inflammation, proceeding to suppuration (or the formation of matter) will cause destruction of the eye. It is lamentable to reflect upon the large number of cases of blindness due to the want of proper precautions being taken to ensure the health of the eye at and from the moment of birth. The treatment which should be accorded to the eyes of the newborn in all cases has been indicated in an earlier volume, and we

Neglect at Birth.

need only remark that the eyes should be properly cleansed with tepid water allowed to drop on the eyeball from the inner side, and thus to wash the surface of the eye, the water being carefully swabbed up with cotton-wool, which should at once be burnt. To the water used to wash the child's eyes a little boracic acid may be added. On no account must any sponge be employed, for we have to bear in mind that however careful we may be in regard to the cleansing and disinfecting of sponges, their absolute purity can never be ensured. The water may drip from a piece of clean or sterilised lint, which should be destroyed after use. On the first appearance of inflammation or of matter in the eye of the newborn child, medical advice should be summoned, seeing that prompt measures will be taken in such cases by the doctor to arrest the inflammatory process and to save the eyesight of the infant. If hygienic measures such as have been described were invariably practised, there would be a marked diminution in the number of cases of blindness, even among nations that are hygienically most advanced, for even the most highly civilised peoples give too little attention to this important matter.

A Thing not to Do.

Another piece of advice to be given is that the common practice of applying a poultice to the eye on all and sundry occasions when any eye affection is present, should be studiously eschewed. It may be said without fear of contradiction that a poultice should never in any circumstances whatever be applied to the eyes. We must remember that a poultice tends to keep in close contact with the eye surface any matter which may form, and it therefore becomes in a very short time a septic and disease-producing application. Where there is any need for the application of warmth or moisture, this will be best effected by the method of cleanly fomentation, to which allusion has already been made. Eye surgeons are emphatic in their condemnation of poultices applied to the eyes as not only failing to relieve eye troubles, but also as tending to convert simple eye troubles into affections of the gravest character.

Skilled Advice.

In connection with the ear, the importance of securing a sound medical opinion regarding ear troubles at their outset has been insisted on, and the necessity for this advice is at least as great in respect of the eye. When anything goes wrong with these delicately constructed organs, the disorder can only be diagnosed by those who have specialised in such affections. Hence the folly of persons attempt-

ing to diagnose and to treat eye troubles on their own account. The onset of certain severe eye maladies may be mistaken for the occurrence of some simple inflammatory process, and valuable time as regards a speedy cure may thus be lost.

Sight and the General Health.

That the eye sympathises with the general health of the body is a statement which the common experience of life amply confirms. Debilitated states of the system exercise a very direct effect upon the eyes, and equally do we find that they are injuriously influenced by erroneous habits. Weakly children frequently suffer from eye affections of various kinds. We may go further, and say that our sight is affected even by our surroundings. Thus, living in an impure atmosphere is calculated to act prejudicially on the eyes, and the same effect is produced by unhealthy dwellings, if not directly, at any rate indirectly, by inducing a low state of the general health.

Neglect in Childhood.

The need for close attention to the eyes of the young on the part of nurses and mothers hardly requires to be emphasised. Yet it is a fact that a great number of cases of eye trouble of a more or less permanent character are to be traced to neglect of the eyes in early life, more especially if eye defects —which, as a rule, are easily detected by the way in which children use their eyes—are left unheeded. The growing practice of testing the eyesight of school children cannot but be highly commended. In the past, many a child has been regarded as extremely stupid at school when in reality it has been suffering from defective eyesight. Not only in children, but in adults as well, certain headaches of a persistent nature are due to eye-strain. The cause of such affections often remains unsuspected. Any condition in the eyes likely to produce strain is easily detected by an oculist, and many a child, and many an adult, has been relieved from what is really a species of torture by the wearing of glasses properly adjusted to the sight.

The defects of vision which depend upon some malformation or alteration of the structure or shape of the eye, are discussed elsewhere in this work. It is the early detection of such defects which we desire to insist upon here. Such a condition, for example, as the development of squint in children is capable of being efficiently corrected by an eye surgeon, if the case comes under treatment at an early stage.

The eyes in adult life are in many cases very unwisely treated and

unduly taxed. Nothing is more common than to find premature failure of vision due to the influence of unwise habits in the use of the eyes.

Abuse of Sight in Adult Life.

As an example of such habits we may refer to reading or writing in an insufficient light. This causes a certain amount of eye-strain which, if allowed to proceed, necessarily results in the production of an abnormal condition of the organ of sight. It is an almost universal habit, for example, on the part of persons travelling by train at night to read newspapers, often badly printed, in the imperfect light. Even if the light were all that could be desired, the habit is not a wise one, for the vibration of the train necessarily exposes the eyes to strain.

Choice of Glasses.

It is not necessary to enter into particulars as to the choice of glasses when they become necessary, but it may be laid down as a general rule that it is always wise to select glasses which are of the lowest power capable of giving comfort in reading. There is an obvious temptation to use more powerful glasses than are necessary, owing to the ease with which the power of seeing becomes in this way reinforced. This temptation should be resisted, the more powerful glasses being reserved for use in after years when the need for them arises.

An important caution may here be given. The art of testing the sight is one that can only be acquired after technical instruction and a large amount of practice, and in all cases an eye surgeon should be consulted, who will give a prescription from which lenses can be made by the optician. In country districts it is no uncommon thing for a travelling pedlar to include a stock of spectacles amongst his wares, and the amount of harm which is done by the irresponsible selection of glasses for failing eyesight through this practice of purchasing in a haphazard fashion can hardly be over-estimated.

The Eye and Sleep.

The relation of sleep to the health of the eyes is a point frequently missed in the consideration of eye hygiene. We should remember that the eyes, like every other organ of the body, tend to become weary and fagged after a long spell of work. Sleep is the natural means whereby we recuperate the organs of the body, and the eyes, of course, share in the benefits conferred by repose. In addition to the mere physical rest of sleep, the eyes benefit also in other directions. A certain eye substance of importance in vision known as the "visual purple" is renewed and reproduced in the darkness of sleep.

Coming now to the consideration of the effects of bodily habits upon eyesight, we may note the influence exercised by alcohol, tobacco, and other substances. Certain authorities have expressed the opinion that the abuse of tea and coffee tends to affect injuriously the eyesight. It is more likely, however, that if the eyesight suffers through the abuse of these beverages it is not so much directly as indirectly, because bodily conditions are induced which affect the sight. With regard to alcohol the case stands on a much more definite basis. Excessive indulgence in alcoholic liquors has certainly a prejudicial effect upon the sight. In this case the injurious results are due probably to the altered condition of the blood.

Effect of Alcohol on the Sight.

Not less certain are the injurious effects upon the eyesight of excessive indulgence in tobacco. In some cases of excess, a condition arises to which the name of "tobacco blindness" has been given. It is somewhat difficult to define the limits of excess in the matter of smoking with reference to the health of the eyes. Our individual constitutions differ largely in this as in other directions. It may be that in cases of tobacco blindness there exists on the part of the sufferers some special predisposition to the malady, but it is tolerably certain that in the vast majority of persons excessive smoking will in time produce eye affections which, if they are not typical cases of tobacco blindness, none the less show how dangerous is the abuse of tobacco. That the effects of excess are less serious in some cases than in others is due, perhaps, not only to idiosyncrasy, but also to differences in habit. Persons who live, for example, much in the open air are less likely to be affected than others whose lives are of a sedentary character.

"Tobacco Blindness."

In respect of the onset of tobacco blindness, the first prominent symptom of which the sufferer will probably complain is that of some impairment of sight. In reading, the words or letters will seem to become confused and to run together, whilst the brain, sympathising with the eyes, induces a feeling of giddiness. Continued attempts at reading cause the eyes to become more distinctly affected, relief being experienced when the reading is suspended for a time. The eyes themselves exhibit a certain amount of congestion and inflammation, and are easily tired; hence a general dimness of sight both for far and near objects is also compiained of. Tobacco blindness is said to be most frequently met with in long-sighted people, and it is regarded as more liable to

occur in those who smoke cigars or short pipes than in those who use pipes possessing a fair length of stem. Entire renunciation of smoking is necessary until the patient has completely recovered. In ordinary cases the giving up of the smoking habit for a time, with careful attention paid to the general health, and the use of proper tonics, will be found to afford relief and to restore the eyes to their normal state. In persons who are over middle age the process of recovery is apt to be more prolonged than in younger subjects.

CHAPTER LXXXI

THE HYGIENE OF BRAIN AND NERVE

The Nervous System and the Body Generally—Blood and Brain—Physiology of the Nervous System—Nerve Cells—Likeness to and Variation from Type—Nerve Cells and Nerve Fibres: their Different Offices—Nutrition of the Nervous System—Fats—Oxygen—Folly of Forcing in Education—Influence of Heredity—The Neurotic Temperament—How it may be Neutralised—The Stress of Modern Life—Sleep—Somnambulism and Hypnotism—Illusions—Memory—Ambidexterity—Sex—The Brain in Old Age.

IN former days it was usual to regard the functions of the brain as standing on a different level from those of the rest of the body. This idea arose from the fact that the work of the brain was of a more subtle and complicated nature than the duties performed by other organs, and the higher functions of the brain being summed up in the word "mind," the duties of the governing centres of our body were regarded as lying to a great extent beyond explanations of a purely physiological character. A better acquaintance, however, with the structure of the brain and nervous system at large has tended to show the complete interdependence existing between it and the other organs of the body. While we still remain ignorant respecting the manner in which many of the functions of the brain are exercised, we have been able to investigate the nature of the apparatus in which the control of the body is vested.

The Nervous System and the Body Generally.

Recognition of the fact that neither the brain nor any other part of the nervous system exists as a separate entity in the body is well brought out by the change which to-day marks the language applied to insanity as compared with the manner in which brain disorders were spoken of in earlier years. Formerly insanity was regarded as a disease of the mind; to-day it is regarded as a disease of the brain This change in conception and nomenclature is justified by the fact that scientific research has not merely been able to place its finger on areas of the

brain which are subject to definite disease, but has also been able to demonstrate the subtle changes of a material nature which occur in those marvellous units of the brain, the brain cells.

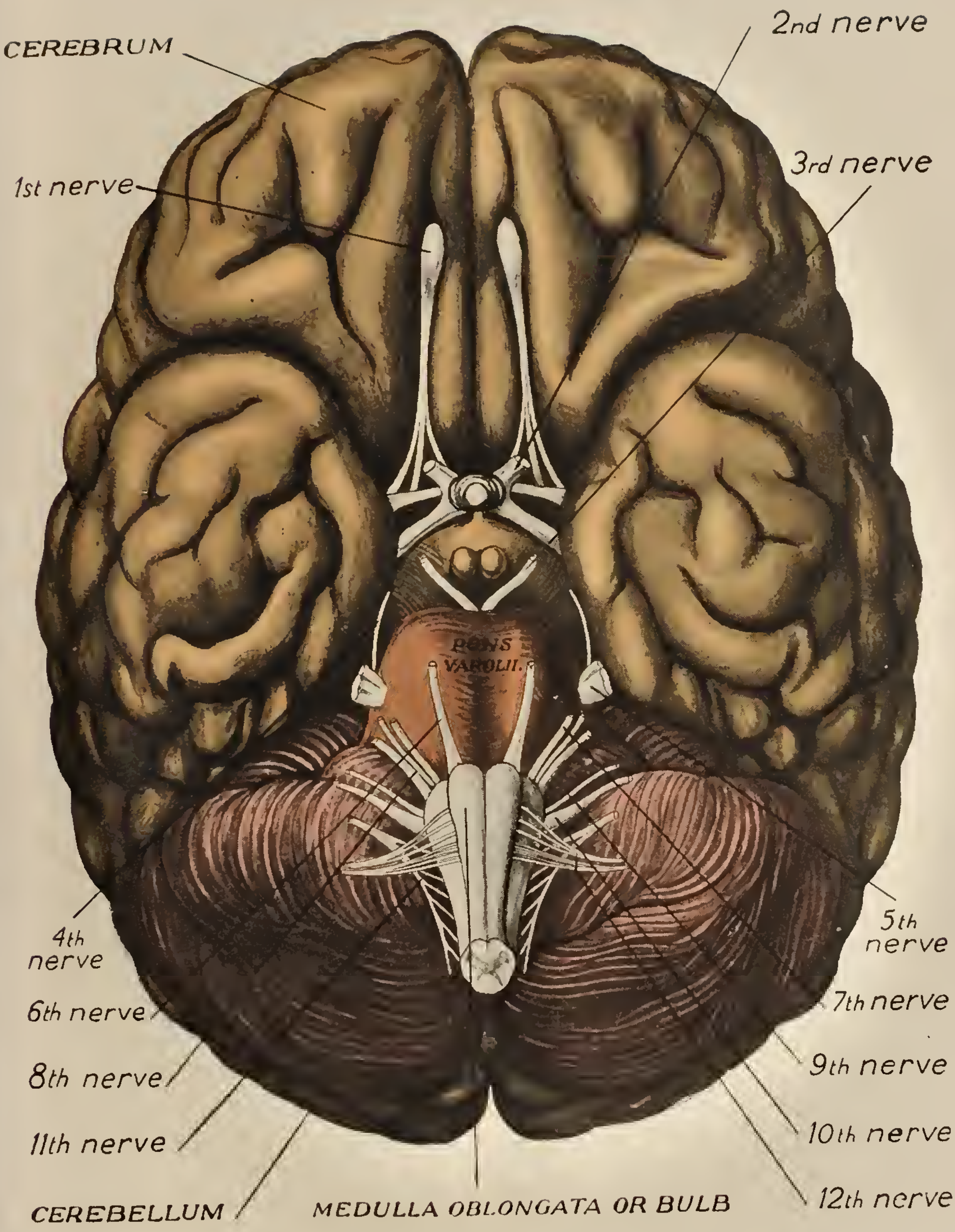
All considerations, therefore, regarding the proper regulation of the nervous system must start from a recognition of its close relationship to the body it controls. Of this intimate relationship a single illustration may be given. The quality of the blood circulating through the body exercises a material influence upon every tissue whereof our frames are composed. If the blood exhibits grave alterations in its constitution, of either a temporary or a more permanent nature, the brain is bound to suffer along with every other organ. Its functions, to be perfectly carried out, demand a full supply of pure, well oxygenated blood, a condition which, in its turn, depends on an adequate supply of nutritious food, and on the breathing of pure air. Lying thus well within the scope and boundary line of our physical organisation, the nervous system is bound to suffer with the rest of the body when unhealthy conditions arise. Again, processes of disease with which we are familiar as attacking every organ of the body also operate injuriously on the brain and nervous system at large. If there is to be the *mens sana*, there must be, as the antecedent condition, the *corpus sanum*.

Blood and Brain.

That brain functions are exercised under conditions more complicated than those which exist elsewhere in the body does not, of course, place the brain outside the purely physical means of research which the scientist brings to bear upon it. Indeed, of late years our stores of knowledge of the functions of the different parts of the brain and of the working of the nervous system generally have been marvellously increased. Many dark places still exist in the field of inquiry as regards both the structure and the physiology of the nervous system, but we possess to-day, in the shape of facts elicited by research, a satisfactory groundwork for a broad view of the manner in which the central nervous system controls our bodily functions.

Physiology of the Nervous System.

It is advisable, before going farther, to recall to mind a few of the physical features which the brain and nervous system present for consideration. It is only on such a basis that the hygiene of these organs can be satisfactorily studied and appreciated. The living body may be compared to a commonwealth of living units, to which the term



THE UNDER SURFACE OF THE BRAIN.

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"cells" is given. Every tissue of the frame consists of these microscopic particles. They occur equally in skin and in bone, in liver and in brain. The cells may be compared to the workmen of the body, seeing that in virtue of the living matter of which they consist they discharge all the duties which the various organs perform. It is evident that cells must possess different ranks or grades of importance. A cell of the skin is less important, for example, than a cell of the liver or a cell of the stomach; whilst the latter in turn, judged by the duties they perform, are of lower rank than the cells which form the units of the nervous system. Again, when we compare one part of the nervous apparatus with another part, we become aware of a difference in the relative importance of the cells of which they are composed. A cell in the spinal cord, for example (which forms the main line of the nervous system, proceeding from the brain and lying protected within the backbone), may be regarded as inferior in respect of the duties it discharges to a cell in the brain, and even when we limit our view to the cells of the brain we discover that they also illustrate the same grouping into different grades. Thus certain cells in the brain are devoted to receiving the impressions conveyed to them from the organs of sense. Other brain cells govern and control the muscles, and certain cells in the spinal cord exercise a like function. Of superior rank are the brain cells, which appear to be connected with the higher functions exercised by the great central mass of the nervous apparatus. On these devolves the exercise of consciousness, the will, and the other faculties which make up what may be termed the essence of our intellectual life.

Nerve Cells.

If we were to compare the nervous system to the government of a country, we might regard the cells that have the control of muscular movements as representing the executive department of the controlling body. Other cells might be compared to an intelligence department receiving impressions and transmitting them to the superior officials, represented by the highest cells of all, which determine the action to be taken as a result of the impressions received.

This rough-and-ready comparison of the constitution of the brain and nervous system to a political government may serve to show that the parts of this complex apparatus are not all of the same value, whilst at the same time they are bound together in the most intimate fashion. Modern physiologists are fairly agreed in the opinion that brain cells,

like other living units of the body, are capable of being variously modified in respect of the manner in which their duties are discharged. It is true that we owe a great deal to inheritance. In the development of life at large we discover at least two tendencies which become of importance when the hygiene of the brain falls under consideration.

Likeness to and Variation from Type.

The first tendency is that through which the living body repeats, to a greater or lesser extent, the likeness of its parent, whilst the second tendency may be summed up in the word "variation," a phrase implying that along with a general likeness to the parental type there is also a process through which differences from that type are produced. It is through the operation of the latter tendency, acting as a principle in life's development, that education exercises its influence in enabling us to develop new ideas, and to extend in greater or lesser degree our mental outlook.

It is highly interesting in connection with this point to know that the number of brain cells with which an individual is born remains the same during life. There is no increase in their number, and when we investigate the purely physical conditions by which mental advance is made, it would appear that the development is due mainly to the growth and multiplication of the connections between the different groups of brain cells, and it may be between individual cells. This mode of brain development might be legitimately compared to the state of a country through which the main line of a railway is first constructed. Communication will at first be obtained only along the direct line. As the railway system develops, branch lines are found necessary as well as loop lines, until the busy district becomes covered with a network of lines, rendering progress easy from any one point to another. So with the brain: the lines of communication between each group of brain cells, we may suppose, are at first few and direct. As, however, development advances and the necessity for the performance of more complex actions arises, the lines of communication are increased. Thus the activities of the brain are more easily carried out, while the structure of the nervous system takes on a high degree of complexity.

The comparison just made is founded upon a consideration of the actual physical structure of the nervous system, for, complex as it is, that system may be reduced to two chief elements—namely, nerve cells and nerve fibres. It is the nerve cells which alone have the

power of originating, of receiving and transmitting impressions. They are the batteries of the body's telegraphic apparatus, the nerve fibres being conductors, and nothing more. In the spinal cord we find both nerve cells and nerve fibres, the fibres conveying messages from the central nervous system to the body, and vice versa, whilst the cells have the power to a certain extent of receiving messages and of dealing with them. In the brain, however, where the greatest complexity of both cells and fibres exists, there are not only brain fibres that convey messages from the brain outwards to the body, and inwards from the body to the brain, but also, like a telephonic system limited to a large warehouse, a vast number that connect together the various cells and cell centres of the brain itself.

Nerve Cells and Nerve Fibres.

Being a living structure composed of protoplasm—that is, of living matter—the brain cell, as we have seen, requires nourishment equally with every other living unit of the body. It is matter of common knowledge that states of the body in which its nutrition is interfered with act injuriously, and in a very marked degree, upon the nervous system. It has often been alleged that particular forms of diet are capable of exercising special effects on the nervous system. A common belief, for example, credits a fish diet with special qualities suiting it to the nutrition of brain and nerve at large. This idea probably arises from the fact that chemical analysis of brain substance reveals the presence of a certain amount of phosphorus in nervous tissue, and from the belief that fish contains a large proportion of this element. That phosphorus forms an essential element of brain and nerve is unquestionable, and was expressed by a great German thinker in the formula, "No phosphorus, no thought." But unfortunately for the popular belief just mentioned, we find that fish does not contain an appreciably larger proportion of phosphorus or of its compounds than do other flesh foods. There is, therefore, no justification for the idea that fish—or, indeed, any other special kind of diet—is to be preferred as a nutrient for the nervous system. The foods adapted for brain nourishment consist simply of those which are best adapted for the nutrition of the body generally. If there exists any food which is of special importance in connection with the nourishment of the nervous system, that food is fat, which is also to be regarded as an essential constituent of nerve tissue. It is

Nutrition of the Nervous System.

very certain that without an adequate supply of fat the general nourishment of the body must fall below par. We may see the importance of fat in the fact that milk, into the composition of which it so largely enters, is the sole food of the infant for the first months of its existence. In debilitated states of the nervous system, physicians have long recognised the value of fat as a food calculated to assist in the restoration of nerve tissue, and the conclusion of the whole matter is that an ordinary diet which includes a sufficiency of fat is best calculated to enable brain and nerve satisfactorily to execute the functions they are intended to perform.

Fats.

The equilibrium of the nervous system is admittedly very easily disturbed, and it is extremely liable, therefore, to suffer from the effects of errors in diet, and from injudicious habits generally. A point not so well appreciated as it ought to be in connection with the health of brain and nerve is the importance of securing an adequate supply of pure air. The oxygen we inhale from the atmosphere is absolutely essential to our well-being, the amount of this gas inhaled in twenty-four hours by a man amounting, strange as it may seem, to about 8⅓ pounds in weight. In the absence of oxygen the oxidisation, or chemical burning, of the foods we consume, giving us energy, cannot be carried out. Deprivation of the gas, even for a short time, as we know, results in death. The cells of the brain appear to require oxygen, if anything, to a greater extent than other cells of the body. Hence, when an impure atmosphere is breathed, and when waste products are not perfectly eliminated from the body, the brain cells are amongst the first to suffer. We have an apt illustration of this truth when we suffer from headache caused by breathing the impure atmosphere of a close, ill-ventilated room, the headache disappearing when a due supply of oxygen is received into the blood and conveyed to the brain cells. To the health of the nervous system, therefore, a constant supply of pure air is absolutely essential. The effects of impure air on other parts of the body are sufficiently recognised, but that the brain cells suffer the most from the lack of this vivifying gas is not so generally appreciated as it ought to be.

Oxygen.

In this connection a word may be said about tea and coffee, tobacco and alcohol, though these subjects are dealt with more fully in other chapters. Neither tea nor coffee is to be regarded as a nerve food.

They both exercise on the nervous system a certain degree of stimulation, due to the active principles, theine and caffeine, which they contain. Any excess of either fluid is to be deprecated, the effects produced on the nervous system being probably both direct and indirect. Over-stimulation of the nervous system will induce sleeplessness and irritability, whilst indirectly the abuse of these beverages, by lowering the general tone of the body, affects the nourishment of the nerve centres. Tobacco is a narcotic and sedative, and its general use among the nations of the world points to an appreciation of its soothing influences. Of the moderate use of tobacco by adults no adverse opinion need be expressed, but any excess is much to be deprecated. In addition to the effects on the eyes, alluded to in the preceding chapter, the nervous system is apt to suffer. It is thrown into a condition of irritability, and the effects are communicated to other systems of the body, including the heart and the digestive organs. Many persons who smoke much late at night are liable to attacks of insomnia, which disappear when the indulgence is kept within due limits.

Stimulants and Narcotics.

As to alcohol, it is impossible to erect any standard which may serve as a criterion for moderation in its use, seeing that individual peculiarities count for so much. No tissues of the body react to the influence of alcohol more quickly than those of the nervous system. When taken in even a moderate quantity, it produces at first a sense of exhilaration and well-being, due to its stimulating action on the nerve centres. Later on this is exchanged for a narcotic effect. If it is taken in excess, the narcotic action very speedily succeeds to the stimulating effect. Probably the most injurious mode of using alcohol is that of taking small doses at frequent intervals. Physiological experiment has proved that the rapidity and exactitude of brain action are diminished in direct proportion to the amount of alcohol taken within a given time. Habitual excess is followed by very definite effects upon the nervous tissue. The protoplasm of the nerve cell undergoes degeneration, and in time, if the excess is continued, the nervous system may be thoroughly thrown out of gear.

With respect to the development of the brain, and having regard to the due evolution of its functions, we may note that, like other organs of the body, a gradual unfolding of its powers represents the method of Nature in the progress from the earlier to the fully developed stage.

To-day it is admitted by all enlightened educationists that attempts to force a too rapid development of the mental faculties must sap the very foundations of successful mind training. Here, again, we must not forget that brain and body are really one, and that whilst an enfeebled body cannot be expected to show a high degree of brain power, so also over-strain of the nervous system must in its turn act injuriously upon the rest of the frame. It is true that great mental power may occasionally be found associated with a weak or even a diseased frame. So also we meet with examples of extreme precocity, especially in the art of music, though such precocious children do not always realise in after life the promise of their earlier years, some of them, indeed, falling below the normal standard. At best such cases are only exceptions proving the rule that the true way in education is a gradual development of the power of the mind and an avoidance of over-strain.

Folly of Forcing in Education.

The question of heritage, and of the influence of parental and ancestral traditions, as affecting the evolution of the brain is one of singular complexity. As a matter of fact, we know far too little regarding the conditions under which heredity operates, even on other and less complicated bodily structures, to enable us to formulate any definite laws, and in the case of the nervous system, with its infinitely more complicated functions, the part played by heredity becomes proportionately more difficult to determine. Some light is possibly thrown on what inheritance implies in the case of the brain by the study of certain disease conditions. The prevailing opinion concerning the handing on from one generation to another of such abnormal states is that whilst a disease may not itself be transmitted, there is handed on a tendency to it. Thus a gouty tendency is liable to be transmitted from parent to child, but the tendency may be modified by careful attention to diet and exercise, and so the threatened affection may be avoided. We have already pointed out, in the case of tuberculosis, that what is inherited is not the disease itself but a tendency to it. A child whose parents are consumptive will therefore be more likely to become infected with the tubercle germ than one whose parents have no such taint. Heredity, therefore, is a matter of "soil" rather than of "seed." It is not so much the seeds of disease that are transmitted as the soil, represented by a frame more liable than a perfectly healthy body to afford lodgment to the germs of disease.

Influence of Heredity.

In connection with the nervous system the question of heredity becomes of extreme importance regarded from the point of view just discussed. A parentage which has exhibited a certain degree of nervous instability is apt to transmit to offspring a strong tendency to the same or a similar condition; and this unbalanced state may, under certain circumstances, become even more deeply and typically developed in the child than in the parent. Such persons are known to medical men by the name of "neurotics," the essential feature being a want of equilibrium in the working of the nervous system and a tendency for the nervous centres to be easily put out of gear. Amongst neurotic cases, broadly regarded, we find one ailment—namely, epilepsy—which in its various manifestations, great and small, appears extremely liable to develop as the result of direct inheritance. The nature of epilepsy has already been fully discussed in the section of this work devoted to the consideration of nervous ailments. It may only here be said that, typically, epilepsy represents a condition of certain groups of brain cells which, escaping the control usually exercised over them, tend to develop a kind of nervous storm, the effects of which are seen on the body at large in the form of convulsive movements and a greater or lesser degree of unconsciousness. In certain cases, it may be added, convulsive movements are present, whilst consciousness is retained.

The Neurotic Temperament.

One point which the hygiene of the brain and the nervous system presents in connection with such cases is that by judicious training and education a healthy condition of the brain may be developed. Thus a child born of a neurotic stock will require to be carefully watched, from the physical side, in respect of its upbringing. The most scrupulous attention must be paid to the diet, to clothing, to exercise, and to all other points in its personal history. Still more important is it to bear in mind that such a child must not be pressed forward in its education, but must have only easy tasks allotted to it, so that the acquisition of knowledge may be a gradual and pleasing process, as opposed to the strain of forcing and cramming.

The recognition of the fact that the brain is liable to be influenced, as is the body at large, by healthy conditions of life and upbringing, lies at the root of all attempts to develop not merely the brain of the healthy child, but also that of the offspring of a neurotic stock. Our educational system still leans too much in the direction of undue

competition. The pupil to-day is not merely grievously burdened with the multiplicity of subjects included in the ordinary curriculum, but is also subjected to constant tests by examination, and so the strain he has to bear is intensified. This point well deserves the attention of those responsible for the upbringing of the young.

What has been said regarding the brain hygiene of the child may also with some modifications be applied to that of the adult. The adult to-day has to take part in a veritable "struggle for existence," far more severe than that in which our predecessors were forced to engage. The conditions of modern life, and the severe competition in which most of us have to participate, tend to produce a state of nervous irritability. A French writer, describing the tremendous activity of modern life in business and in other directions, remarks that existence to-day holds "no repose." The state of things thus indicated cannot fail to exercise a harmful effect on the nervous system above all other organs of the body. It is by brain and nerve that the burden and heat of the day, so to speak, have to be borne; and each year that passes only seems to increase the strain under which the life of the busy man is passed. It becomes, therefore, a serious question whether in time the race will not inevitably develop a higher degree of that neurotic tendency to which allusion has been made. If this evil is avoided, it will only be by our taking to heart in time the admonition to slacken the pace. We must also be on our guard against the tendency to luxury and self-indulgence which is to be noticed among the civilised races to-day. Every movement which favours simplicity and moderation in the matter of eating and drinking, and in the conduct of life at large, is to be commended.

Stress of Modern Life.

It has been well said that whilst sleep may to a certain extent replace the need for food, no amount or kind of nourishment can make up for the lack of sleep. In former years sleep was believed to be associated with an altered condition of the blood supply of the brain. It was assumed that, it having been discovered that a smaller quantity of blood flowed to the brain during sleep, the problem was solved; but the real question, the cause of this brain anæmia, was left untouched. More recent researches have enabled us to understand—provisionally, at any rate—the behaviour of the brain cells in activity and in repose respectively. A brain

Sleep.

cell in its most typical development is found to give off a large number of processes or filaments known as dendrites, by means of which it is brought into communication with its neighbour cells. It is now known that the ends of the branches of brain cells are only in contact, and are not continuous with each other. They can, in fact, be extended and retracted. In their active condition the dendrites are extended, and are in contact with those of neighbouring cells, thus affording the means of communication between cell and cell. When the brain cells become fatigued, and the need for repose becomes evident, the dendrites appear to undergo a process of retraction, so that the contact between the cells is temporarily broken. It is this latter state which appears to be characteristic of sleep, and this alteration of brain cells may be held as a convenient working theory to explain the onset of drowsiness. However this may be, it is evident that all theories of sleep must take as their starting point the weariness of the brain cells, due to work.

The infant may be said to spend the earlier months of its life in sleep, only waking to receive nourishment. Throughout the period of youth, also, the necessity for abundance of sleep is obvious. In the case of the young child twelve hours' sleep out of the twenty-four is not by any means too long a period, and the probability is that for boys and growing youths at school the amount of repose hitherto regarded as adequate might with advantage be extended. Whilst individual differences of constitution have to be taken into account in the case of adults, there can be little doubt that the average man or woman, in order to keep the brain and nervous system in a healthy state, should have not less than seven hours of repose, and men whose brains are actively engaged may with advantage have eight hours' sleep. Physicians lay great stress on rest as a curative agent in many cases of disease, and an adequate amount of sleep may be regarded as a preventive of many abnormal conditions specially affecting the brain and nervous system.

Sleeplessness.

Cases of sleeplessness may arise from other causes than an unduly excited condition of the brain cells, but in the vast majority of instances it will be found that in the absence of pain, brain fatigue is responsible for the origin of this distressing affection. The cure of insomnia, or sleeplessness, is a matter for the physician, but by the observance of hygienic conditions much may be done to recover the power of sleep. All over-strain should be

carefully avoided, and every effort should be made to prevent the mind from dwelling upon things that occasion worry. The bedroom should be quiet and well ventilated. The breathing of an impure atmosphere, whilst it may produce a sleepy or drowsy feeling in certain circumstances, may also cause wakefulness ; or the sleep that is had under such conditions may not refresh and reinvigorate as sound sleep ought to do. We have already pointed out that when the brain cells are supplied with a lessened amount of oxygen and an increased amount of carbonic acid gas they necessarily suffer. Occasionally a walk before bedtime will be found to promote sound slumber. A heavy meal partaken of before retiring to rest represents a disturbing influence in that the activity of the digestive organs necessarily interferes with that general repose of the body, that slowing down of all the vital processes, which is conducive to sleep ; but a quite light meal taken an hour or so before bedtime will sometimes be found to induce sleep, more especially if a long interval has elapsed since food was last taken. The use of hypnotics is to be deprecated except under medical advice, as has been insisted upon elsewhere.

Disordered sleep is hardly less of an evil than sleeplessness itself. This topic relates itself to byways of brain action, such as are represented by somnambulism, hypnotism, and allied states. Disturbance of repose may take the form of intermittent wakefulness in which the patient sleeps for a short time, wakes, and then has another short sleep, and so the night is passed, with only short snatches of real rest for the jaded brain. In other cases disturbed rest takes the form of dreams, sometimes of the nightmare order. When such conditions exist, tending as they do to produce weariness and lassitude, it will be well that the state of the general health should be closely scrutinised. Apart from mental worries and similar cases of sleeplessness, there may be disorder of the digestive system, and especially of the functions of the liver, and there may be unwise habits that call for correction, such as the excessive use of tobacco or alcohol.

Somnambulism.

In somnambulism the subject rises from his bed, and may execute a series of more or less purposive acts, remaining all the while unconscious of his surroundings. On awaking he may either exhibit some dim idea of what he has done in his sleep, or may be entirely oblivious of his actions. Thus a young woman has been known to rise from bed and write a short essay correctly.

The same patient wrote a post card and correctly addressed it whilst in a state of unconsciousness. On being tested in her waking state under the same conditions of dim light, and made to write the same address on a post card, the attempt was a failure. Similarly mathematical problems have been solved by somnambulists, the writing, although the eyes were closed, being clear and distinct. Such cases are of interest from the standpoint of brain hygiene, as well as from the psychological point of view. They should receive the attention of the physician because of their liability to develop serious brain disturbance, apart altogether from the risk occasionally run of injury being sustained whilst in the somnambulistic state.

Hypnotism.

Hypnotism must be mentioned here, although it has been noticed elsewhere. It consists in a switching off, so to speak, of the higher brain centres, and the abolition for the time being of consciousness and will, so that the lower brain centres guide the actions of the individual under the suggestion of the operator. There is a strong likeness to be perceived between sleep walking and hypnotism, and the former state has been appropriately termed one of self-induced hypnotism. Undoubtedly a vast deal of quackery has been associated with mesmerism, as hypnotism used to be called, but it is now recognised by science itself that the terms connote a condition of brain which may be induced in various ways, either by causing the individual to look fixedly at some object, or by the mere suggestion of the operator. Some persons are found to be more susceptible to hypnotic influence than others, and some cannot be hypnotised at all, even though they desire to be. Where hypnotism is employed in the treatment of brain conditions, it should be only under the sanction of a medical man. Impressions made on individuals during the hypnotic state are followed in certain cases by the correction of bad habits. In the case of alcoholics, for example, the suggestion can be made during the hypnotic state that alcohol is unpleasant, and in many cases the impression thus produced persists, and the habit is broken off because strong drink has become obnoxious to the taste.

Hallucinations.

Illusions of sight and illusions of hearing are extremely common, even among those who are perfectly sane. Thus a ringing in the ears may suggest the sound of bells, and when the eye is irritated flashes of light may be seen. Neither sensation is derived from the outer world, but arises solely from within, and may be

regarded as a direct result of some irritation applied to the organ of sense involved in the production of the illusion.

It was remarked in the chapters dealing with the hygiene of the ear and eye that injuries to the head affecting the brain were capable of giving rise, in certain circumstances, to the conditions known as brain deafness and brain blindness. Such an injury interferes with the stability of the brain centres devoted to the reception of impressions from ears and eyes respectively, these latter organs themselves being intact and capable of responding to sensations from the outer world. In this case the receiving office is deranged, and hence messages from the outer world inwards cannot be dealt with as in the healthy state. Proceeding a step farther, we find that on occasion the brain centres may exhibit a power of affecting the sense organs from within outwards. One writer has well described this power by saying that consciousness has a background as well as a foreground. From the background of consciousness, and travelling, therefore, the reverse way of naturally received impressions, an influence may be brought to bear upon sense organs which gives rise to sensations resembling those received from the outer world in the ordinary way. Ringing in the ears and flashes of light before the eyes exemplify results of this irritation of sense organs from within, and to this form of sensation, as opposed to the natural or objective mode of sensation, is applied the term "subjective" sensation.

It is in this way that the hallucinations of the sane originate. Medical literature contains countless illustrations of the development of hallucinations which have been duly chronicled by those subject to this form of brain irregularity. Towards the end of the eighteenth century Nicolai, a well-known bookseller of Berlin, began to be troubled by visions of figures which swarmed in his room and accompanied him everywhere. He took particular note of the shadowy figures which appeared to him, noting their dress and deportment. Later on hallucinations of hearing were joined to those of sight, and he heard his spectres talk, not merely to one another, but also to himself. This man, who gave an account of his visions before the Royal Society of Berlin, was perfectly conscious that the figures he saw had no real or objective existence. They disappeared when he underwent a process of bleeding—in those days a common remedy for many affections. Sir David Brewster, in his "Natural Magic," gives an account of a lady who in similar fashion,

owing to ill-health, was troubled with hallucinations of the sight. She saw the figure of a cat resting on the hearthrug close to a dog which could not tolerate the presence of a feline neighbour. The figure of her husband, who had left the house a short time before, was seen by her standing in front of the fire, but she duly noted that through the spectral object she was looking at the flame of the fire could be distinctly seen. An aunt who had died a short time before also formed the subject of one of her spectral visions, and rather curiously she saw the aunt dressed in a gown which she had never herself seen, but the pattern of which had been described to her in a letter.

A familiar illustration of this irregular action of the brain is that seen in the case of the drunkard affected with delirium tremens. In his alcoholic excitement he fancies he sees animals of various kinds, such as rats and snakes, crawling over his bed. There are other forms of illness, ranging from slight derangement of the health to the delirium of fever, of which such delusions form a frequent symptom. Happily they do not necessarily mean that there is any organic disease of the brain. Such cases require attention paid to the general health, rest—if, as is commonly the case, there has been overstrain of the nervous system—and a course of tonics, combined with attention to the other points connected with the restoration of health.

Memory.

One of the most interesting topics included in the consideration of the hygiene of the brain is that of memory. It need hardly be pointed out that no series of functions performed by the brain is of higher importance than that to which we apply the collective term "memory." The means, therefore, which may be taken from the standpoint of hygiene, not merely to retain but to improve the memory, is a matter of the highest interest in connection with our mental powers.

Seat of Memory.

It is difficult to determine the exact seat of the memory. In the old days of phrenology the surface of the brain was mapped out into definite areas or localities, each corresponding with a given mental faculty. This system of brain localisation, it need hardly be said, has been discredited by modern research. No such correspondence between the brain and its bony casket as phrenology assumes exists, and when, further, we remember that large masses of brain cells exist in brain regions far removed from the surface—as, for example, in the base of the brain—it becomes evident how baseless are the pretensions of this so-called science of mind.

In opposition to the idea that any one area of the brain is specialised for the discharge of the functions of memory, it is more consonant with what we know of the work of the brain cells in other directions to believe that each of these living microscopic units possesses a memory function of its own. We might, indeed, suppose further that amongst the hundreds of millions of brain cells which exist in the brain, there might be special memories assigned, not indeed to a single group, but to a number of special groups of brain cells, so that recollective powers of special kinds would be distributed in this fashion amongst the various centres into which the cells are grouped. Certain interesting facts would seem to lend some measure of probability to this latter theory of memory. For example, a person may be able to recognise his friends—that is, his recollection of their personalities is not impaired—when his memory for written and spoken words has disappeared. Such facts strongly suggest the localisation of a memory, so to speak, for each brain function, and from this standpoint it might be argued that every brain cell is the seat of a special form of memory. A patient, again, has been known to lose all memory of the words of his native language, whilst retaining the power to write or to speak a foreign language which he had acquired. Such a case can only be explained on the theory that even in the language centres of the brain there must exist different groups of cells, charged with the duty of reproducing different languages.

Memory Training.

Of all functions of the brain, the memory is the most easily improved by culture and exercise. Yet how little trouble is taken to cultivate it in any but a haphazard way! The foundation of most systems of memory training is discovered in the principle known as the association of ideas. As a matter of fact, the events of our life, trivial and grave alike, are all linked together more or less directly, and when we speak of "trains of thought" we unconsciously testify to this fact. The memory systems take advantage of this principle of the association of ideas by artificially framing for the pupil's use certain easy formulas whereby the recollective powers are led, step by step, to institute a kind of linkage, with the result that one idea or thought suggests another. If in course of time such a habit, applied to the special wants of an individual, becomes stereotyped in his mental work, his memory for the special details becomes strengthened and improved. It would seem to be a pity, therefore, that some form of memory training is not included

in the education of children generally. It is quite conceivable that we really forget nothing we see or hear. Locked up in our wonderful brain cells are countless memories of impressions, of the existence of which we are not ourselves aware until it may be some chance occasion brings them to the surface. It would seem, however, that a certain period must elapse for the registration in the brain cells of the impressions derived from the outer world. In cases of concussion of the brain, the patient's memory for the events which immediately preceded his accident, during some hours at least, is completely and for ever abolished, whilst his recollection of events that occurred farther back than the period referred to remains as clear as ever. One way of accounting for this strange obliteration of memory is to assume that a certain time must elapse for impressions to be fixed, as it were, in the process of mental photography.

The exercise of memory might in some respects be compared to the arrangements in the shop of a photographer, who is busily engaged daily in taking photographs that after due preparation are printed off from his negatives. The negatives themselves are stored away for future use. If the photographer is orderly and systematic, each negative can be readily found, because it is properly classified. If, on the other hand, he is careless, it will be difficult to discover any particular negative or series of negatives amongst the vast stock he has accumulated. So with the brain. The well-trained memory finds its negatives, so to speak, at once, and rapidly reproduces the ideas demanded, whereas the untrained memory experiences great difficulty in discovering the particular recollection it is desired to recall.

The causes which excite particular memories are very varied. Physiologists are inclined to believe that the sense of smell is that which, of all others, most readily gives rise to memory impressions. This is probably correct, and it is equally true that in many lower animals the sense of smell operates very powerfully indeed, and enters largely into the guidance and control of their lives.

A topic of practical interest in connection with the brain and its functions is that which relates to the prevalence among most nations of right-handedness. In order to appreciate the reason for this phenomenon, we must remember that each half of the brain governs the *opposite* side of the body, whilst at the same time each half of the brain may be said to possess a limited command over its own side. The fibres

or telegraph wires of the nervous system proceeding from each half of the brain are known to cross at the upper part of the spinal cord, and to be conveyed down the main line of the nervous system to control the opposite side of the body. The left half of the brain is better developed than its right neighbour, hence "right-handedness" may be described as implying "left-brainedness." To what conditions the selection, so to speak, of the left side of the brain as the "predominant partner" is due is difficult of determination. We may either suppose that the left lobe of the brain, through some favouring influence, acquired greater power of dominance than its neighbour half, or, on the other hand, we may assume that the more specialised actions of the right side of the body may have themselves initiated this disparity of brain power. The more constant use of one arm especially, in preference to the other, would thus be followed by a correspondingly greater degree of activity in the left side of the brain. The speech centre is in the left lobe of the brain, whilst a similar centre exists in the right lobe, but lies in a dormant condition; but it may be supposed that left-handed persons, in whom the right side of the brain may be regarded as the more active, will probably utilise the right-lobe speech centres.

Right-handedness.

Departures from the ordinary right-handed type of humanity are seen in left-handed persons and in those who can use both hands with equal facility. Those who argue for the cultivation of ambidexterity have much reason on their side. It is certain that practice, especially in youthful subjects, is capable of producing wonderful results in the services which may be performed by the left hand. Thus specimens of writing by the left hand after only six weeks' practice show a very clear and distinct caligraphy, and in some cases the development of left-handedness can be achieved with no great difficulty. As to the medical advantages of ambidexterity, no less an authority than Sir W. R. Gowers asks the question: "What would be the effect on the functions of the brain of the systematic cultivation of ambidexterity? By this I mean the systematic compulsory use of the right and left hands equally for all manual occupations, including writing. . . . The result would certainly be, as far as can be judged from present facts, to acquire an immunity from the grave effects to speech of disease of either side of the brain, should such disease occur." Another writer, Dr. G. V. Poore, speaking of writer's cramp, says that "we educate the left hand

Ambidexterity.

far too little. Girls in this respect are better than boys, for such exercises as piano playing and knitting encourage a great amount of ambidexterity in girls. Why should not the clerk use either hand alternately, and so give to each its much-needed rest?" Again, speaking of the education of the right speech-centre brain cells, situated in what is known as Broca's convolution of the brain, Dr. Poore inquires, "What effect has the exercise of the periphery (the external) upon the development of the centre? By constantly using the left hand for writing, may we not possibly educate our right Broca's convolution instead of letting it lie idle?"

With regard to the other advantages of using both hands, there can be little doubt that many forms of mechanical work would be more easily performed if the left hand were educated equally with the right. The loss of service that the left hand might be trained to render is undoubtedly a somewhat serious handicap to the efficiency of the human race. It is significant to note that the Japanese, who have carried national efficiency to so high a pitch, are ambidextrous above all other nations, and we might in this respect learn a valuable lesson from the East.

Brain and Sex.

Let us next consider sex in relation to brain development and education. Whilst among the lower animals the female is frequently larger and more robust than the male—a fact well illustrated in the case of birds—in the class of mammals, at the head of which man is placed, the male is of larger bulk than the female. Possessing a heavier frame and a more massive organisation throughout, it is only natural to expect that the male brain will exceed the female brain in size and weight. The average weight of the male brain may be stated to be about 48 ounces, the female brain weighing from 1½ to 2 ounces less. This, however, is a precarious ground upon which to base any belief in superior intellectual capacity. It is the opinion of many authorities that there is no distinct relationship to be traced between the weight of brain and the mental powers of its possessor. The cells which represent the active units of the brain are, for the most part, situated on its external surface, which is thrown into convolutions or folds. The brain is composed of grey and of white matter; and the latter consists exclusively of fibres which, as we have seen, are occupied solely in carrying nerve messages to and from the brain. Thus there are diverse elements to be taken into account, and

one sees how hazardous it is to estimate intellectual calibre by brain bulk.

Again, we have to remember that the brain cells themselves are of varied ranks, and only those of a particular region in the brain—namely, the pre-frontal region—discharge functions to which the term intellectual can be truly applied. This is a further reason for questioning the common belief that there is any definite relation between the size of the brain and mental endowments. Intellectuality, in so far as its physical basis is concerned, would seem to depend not so much upon the quantity as upon the quality of the brain cells.

While the hygiene of the brain in man is not essentially different from the hygiene of the brain in woman, it has to be remembered that woman, speaking generally, is more emotional in temperament than man, is more intuitive in her modes of thought, and in respect of the general working of her nervous system exhibits a greater vitality than man, as is indicated by the rapidity of her mental operations.

The Female Brain.

An eminent authority on education, Professor H. H. Donaldson, in his work entitled "The Growth of the Brain," sums up in an interesting fashion certain important points. "While from the anthropological standpoint," says this author, "there is a typical man and a typical woman for each race, these are not the same for different races. In the secondary sexual characteristics there are some distinctions of general applicability; for instance, women are, on the average, smaller than men. Stature and weight are, together with proportion, the best-marked secondary characteristics by which the sexes are distinguished, and yet these overlap in every way. Among such secondary characteristics is that of the nervous system, and there we find a similar overlapping. There is no question about the fact that women have, on the average, smaller brains, though the record from a better class of women than those furnishing the data now employed would perhaps raise the average, but these in turn must be compared with records from a better class of men. This small absolute weight is in no wise mitigated by the fact that the weight of the brain as compared with the weight of the body is greater in woman than in man. . . . If that were a criterion we should all bend before the massive intelligence of the newborn child, whose proportional brain weight is six times greater than that of the adult. The suggestion has been made that the female brain is lighter

because its structural elements are smaller. Granting this, the significance of the absolute size of the elements still requires to be explained. The only interpretation that we have for the size of these elements is as an expression of the power to store and discharge force in a short period of time, and to furnish branches for structural connections. Such a brain of small elements, no matter to which sex it belongs, has the same characters, but so complicated are the reactions of it with intuitive conditions that any inference from mere size has little value. If the inference from size were applied thoroughly, mental superiority would reside with the tall as contrasted with the short man, since, as a rule, tall men have the heavier brains. Size, therefore, has a meaning, but is by no means entitled to dominate the whole interpretation of the central system. There is little or nothing in the weight relations of the female encephalon to show it different from that of the male: In reactions, however, the female has a more local responsiveness than the male, and back of all this is the matter of general physiology, which has its distinct modifications according to sex. Moreover, it is impossible to escape the conclusion that in woman natural education is completed only with maternity, which we know to effect some slight changes in the sympathetic system and possibly the spinal cord, and which may be fairly laid under suspicion of causing more structural modifications than are at present recognised. Basing the inference on the size of the structural elements, we should infer that the typical central system in the female would be more easily fatigued and also be slightly less complete in organisation."

Up to a certain age, which may be regarded as that at which puberty is established, the education and hygiene of the nervous system in the two sexes may be virtually the same, but the occurrence of puberty means much more to the girl than to the boy. In woman puberty is associated with the development of the menstrual function, and this latter in turn is related to that of maternity. Woman as a prospective mother, therefore, may be regarded as entering upon a far more significant era of her existence when puberty occurs than does the youth. The physiological disturbance of the system experienced by her is associated, too, with changes in disposition, marking the effect of brain development in certain new directions. Hence, whilst the general health of the girl at this period demands special attention, it is also to be noted that in respect of brain functions there must be exercised

great care against any overstrain, especially in the matter of education.

In Great Britain our educational systems have by no means been free from the charge of overstrain in the education of girls, but American medical men have had to protest in the strongest possible terms against the overstrain in the systems of American education. An educational authority in America, remarking upon the influence of study on girls' health, says: "At certain periods, I think that study with girls should wholly cease for some days. I refer to girls from twelve to twenty years of age. Anyone who has taught boys and girls in separate schools must have noticed the greater frequency of irregularity of attention of the latter, and as a parent he would know the reason and necessity for the cessation of their work." Another teacher remarks: "The custom of keeping girls between the ages of thirteen and nineteen out of school and at moderate rest during certain periods becoming established among us, a certain number might suffer restraint not absolutely demanded, but the general result would be an incalculable gain to the health, present and prospective, of the inhabitants of this commonwealth." Sir James Crichton-Browne, dealing with the subject of girls' health in relation to education, says: "Already we hear in England of distinguished girl graduates being incapacitated for work by brain exhaustion and bodily infirmities similar to those which have been alluded to as affecting American girls devoted to intellectual work; nay, more than this, we hear of many exceptionally well-educated and clever girls sinking into pulmonary consumption. It may be that in cases of the latter kind the intellectual vivacity which so often accompanies incipient phthisis has guided to the excessive study; it may be also that the excessive study has induced the phthisis, and few physicians will doubt that if female education is to be carried on between the ages of fourteen and twenty without careful adaptation to the requirements of the female organisation, we shall have many cases of pulmonary degeneration directly or indirectly resulting from it."

Overstrain in Education.

In our thoughts upon the hygiene of the nervous system, we finally arrive at the consideration of the treatment of the aged, with the aim of conserving, as far as possible, the healthy constitution of the nervous system, and so of aiding the influence of general hygienic measures to prolong life to its utmost extent. In old age the weight of the brain begins to diminish by the gradual absorption of its substance. As far as we

know, this disappearance of brain substance takes place throughout the entire mass of the brain, affecting not merely the grey matter but likewise the white. In favourable circumstances the general intellectuality of the individual does not necessarily become impaired with age to the extent which might be supposed. There are many cases recorded of persons who have maintained their mental vitality even at a very advanced age. This remark specially applies to men who have led an intellectual life. In persons whose mental activities are of a lower order, there appears to be a greater liability for old age to produce symptoms of degeneration, and at an earlier period. Eminent judges, lawyers, physicians, teachers, and divines, for example, are known to preserve their mental powers almost in their integrity up to a very advanced age, whilst men whose work is not of an intellectual character make a much earlier approach to the state of mental decrepitude. These results are difficult to explain, except on the view that intellectual work carried on through long periods of time imparts to the brain cells an unusual measure of elasticity and vitality. In old age there is obviously not less, but more, need for avoiding undue strain than at earlier periods, especially as in many cases sleep comes less readily than it was wont to do before.

The Brain in Old Age.

CHAPTER LXXXII

HYGIENE OF THE HEART AND THE DIGESTIVE SYSTEM

The Heart a Hollow Muscle—Overstrain—Other Simple Causes of Heart Trouble—How the Heart may be Rested—Digestion and the Heart—The Digestive Glands—Why Blood Flows to Them after a Meal—Errors in Diet—Sir William Roberts's Theory—How often Food should be Taken.

HYGIENE OF THE HEART

No words need be wasted in insisting upon the importance of keeping the heart in proper working order, for even those who know little of the science of physiology fully understand that it is the mainspring of the circulation of the blood, and that through its constant work every living cell of the frame is supplied with sustenance.

The heart itself is a hollow muscle, a description which applies equally to all hearts, from that of the insect to that of man. Muscle, as we all

A Hollow Muscle.

know, forms the flesh of an animal's body, and is the tissue by the contractions of which the various movements of the body are carried out. The same form of energy, therefore, by which we open or close our fingers, or by means of which we move our lips and tongue in speaking or our legs in walking, is that by which the vital fluid is everywhere distributed through our bodies. The heart belongs to the category of "involuntary" muscles—that is to say, they act independently of the will. To this category belong the muscular layers of the stomach, the muscle of the pupil of the eye, and the delicate muscular fibres which enter into the structure of blood vessels. Voluntary or striped muscles, on the other hand, act under the command of the will, and are represented by the muscles of the limbs, head, and neck, and by those of the body at large. Involuntary muscles are governed largely by that part of the nervous apparatus which is known as the sympathetic system. This system controls not only the heart, but also the movements of the stomach and intestine in digestion, the secretion of bile by the liver, and of pancreatic juice by

the pancreas, and many other functions as well. It is remarkable that the regulation of many important functions of our bodies should thus be carried out independently of our consciousness, but through this division of labour the brain and spinal cord are relieved of a considerable amount of work.

Overstrain.

Like all other muscles, the fibres of the heart are apt to grow tired and wearied, and while it is their office to send the blood stream coursing through the body to nourish all its tissues, they on their own part require for the due continuance of their powers of work a supply of healthy blood. Strain of the heart muscle will act even more injuriously than strain of ordinary muscle, for the reason that the heart's action is of a rhythmic character, proceeding more or less constantly, and is therefore more liable to suffer from disturbance of its natural rate of work. The heart muscle, in other words, is especially liable to lose its tone—by which is meant its power of adequate contraction ; whilst recovery of tone, or the ability to discharge its accustomed work efficiently, is apt to be a slow and tedious process.

Other Causes of Heart Trouble.

The heart disorders which most frequently arise, and which are mostly due to errors in living, are of the functional as distinct from the organic variety. Want of sufficient sleep will frequently irritate this organ, just as excess in the use of tobacco and of alcohol will give rise to irregularity of its action. Serious injury to the heart, injury which may develop into organic mischief, may be inflicted by unwise persistence in training for athletic sports on erroneous methods. Indeed, even so-called regulated training for athletics may occasionally leave the heart in a somewhat damaged state. It is not every person who is qualified by his physique to develop athletic powers. The greatest care should therefore be taken by all who indulge in active sports to obtain a definite medical opinion regarding the state of the heart, both before training is undertaken and during its course.

How the Heart may be Rested.

The question of rest is of great importance in connection with functional disorders of the heart, such as are liable to arise from abuse of tobacco and alcohol, from want of a sufficiency of sleep, and from other causes. It is, indeed, upon rest that we must chiefly rely for the correction of errors calculated to produce irregularity of the heart's action. In order to show what rest is capable of doing for an irritable heart which has

been subjected to overwork, we may quote the calculation of a high medical authority, to the effect that with perfect rest in the horizontal position its work is lessened by some 17,280 beats in twenty-four hours. Through this lessening of the work of the heart great good is accomplished in all conditions where irregular action has been induced.

Digestion and the Heart.

From the very nature of its work, the heart sympathises very intimately with the functions of many other organs of the body. Anatomically, it is in close association with the stomach, and stomach and bowel disorders—especially those of which distension of the stomach is a symptom—are apt to affect its working, and to give rise to the sensations described as palpitation. That irregularity of digestive action may exert an influence on the heart is a fact worth bearing in mind, for many suppose that they are suffering from actual heart trouble when really it is only the digestion that is at fault.

HYGIENE OF THE DIGESTIVE SYSTEM

The general health of the body is largely and intimately dependent not merely upon the quality and amount of food consumed, but also upon its being properly digested—upon its complete conversion into a state in which it can be readily absorbed by the tissues of the body. Erroneous habits in respect of feeding are, as everyone knows, responsible for a large amount of disease, ranging from comparatively trivial to grave disorders.

The digestive system of any animal may be compared to a tube running through the body, and having a dilated or expanded portion, the stomach, in which the food remains for a certain time in order that it may be subjected to those digestive changes which it is the office of the stomach to bring about. The kinds of food over which the stomach exercises this special power are those which are known as nitrogenous, such as the white of egg, the juice of meat, and the curd of milk. But it is in the intestine that the greater part of the food we eat is digested—that is, the starches, fats, and sugars.

Attached to the side of the digestive tube are certain organs known as digestive glands. These are illustrated by the salivary glands, which pour saliva into the mouth; by the gastric glands, secreting the gastric juice of the stomach; by the liver, manufacturing bile; by the pancreas, manufacturing the sweetbread juice; and by certain glands

in the bowel, the secretions of which appear also to exercise a certain digestive action on the food.

The digestive system, therefore, presents itself to view as one which, having regard to the labour it is daily called upon to perform, demands the expenditure of a large amount of energy, not merely for the actual work of food assimilation, but in the preparation and manufacture of the various fluids, ranging from saliva to bile, which, poured upon the food, chemically and physically change it so as to fit it for being added to the blood.

The Digestive Glands.

During digestion, an increased flow of blood takes place to all the organs occupied in the work. The blood is withdrawn in a measure from the body surface, and what may be termed a temporary or physiological congestion or fulness of the blood vessels of the digestive system ensues. This blood may be regarded as representing the raw material out of which the cells of the digestive glands manufacture the fluids that act upon the food. Since energy has thus to be expended in digestion, it follows that the saying, "After dinner sit awhile," is a piece of advice founded upon a sound physiological basis. To indulge in active exercise just after meals is to burn the candle at both ends, to divert from the digestive system some of the energy which is required for the preparation of the food for assimilation.

Amongst the errors in diet against which a word of warning may be given is the habit of taking large quantities of fluid with meals. A diet which is over-dry is a frequent cause of constipation; but, on the other hand, if large quantities of fluids are drunk with meals there may be undue distension of the stomach, caused by fermentation and the production of gases, a result which is more especially to be looked for where much starchy food enters into the diet. The kind of fluid taken to excess is comparatively unimportant in this aspect. Large quantities of plain water, if taken with meals, may disorder digestion just as less innocent fluids may do. Another effect produced by too much drinking at meals is undue dilution of the digestive secretions. If the food is to be perfectly digested, the fluids whose business it is to do the work must not be too much weakened.

Errors in Diet.

The effect of certain fluids taken with meals was made the subject of an elaborate series of experiments by the late Sir William Roberts, M.D. Tea, coffee, and practically all wines were found to exercise

an inhibitory or retarding influence upon digestion, not merely in the mouth, where starch is converted into sugar by the saliva, but also in the stomach. In some cases—and especially when tea or coffee was consumed with meat—digestion was completely stopped for the time being. A "meat tea" is a meal extremely difficult to digest, and persistence in such a dietary is almost sure, sooner or later, to develop digestive troubles. Experiment, however, has shown that in the case of salt foods tea or coffee does not exercise the same retarding influence, and of fish probably the same may be said.

Sir W. Roberts's Interesting Theory.

Referring to this subject, Sir William Roberts, in his work on "Digestion and Diet," points out that the common practice of taking coffee after dinner might to a certain extent be justified on the ground that modern cookery having to a large extent rendered the work of digestion rapid and easy, there was less opportunity afforded for the natural digestion of food than is proper and necessary for health. "Is this retardation," he asks, "wholly or even at all evil? Do we healthy people take tea, coffee, wines, or beer with our meals for some collateral good, and in spite of their untoward retarding effect on the chemistry of digestion, or is there really some good in this retardation itself? And do we unconsciously use these beverages partly for this very purpose of abating the speed of gastric action? It requires, perhaps, great courage to set forth and to defend a proposition apparently so paradoxical as that men take these beverages in part with the unconscious purpose of retarding their digestion. . . . The view I am about to suggest concerning digestive retardation may be true or false, and must submit to the test of criticism; but the facts indicated by the experiments stand equally fast, whether that view prove true or false. It does not really require much ingenuity to show cause why retardation of gastric digestion may be regarded in the healthy and strong as having a beneficial purpose. We must bear in mind that among civilised races the preparation of food for the table is carried to a high degree. The cereal grains which are employed to make bread are first finely ground and sifted from the bran by the miller; the flour is then subjected, with the aid of moisture and artificial heat, to a cooking process; the meats and fish we eat are boiled or roasted; the vegetables we use are carefully deprived of their coarser parts and then are boiled; all this preliminary preparation and cooking renders our food

highly digestible and easy of attack by the digestive juices. . . . A too rapid digestion and absorption of food may be compared to feeding a fire with straw instead of with slower burning coal. In the former case it would be necessary to feed often and often, and the process would be wasteful of the fuel; for the short-lived blaze would carry most of the heat up the chimney. To burn fuel economically, and to utilise the heat to the utmost, the fire must be damped down, so as to ensure slow as well as complete combustion. So with the human digestion, our highly prepared and highly cooked food requires in the healthy and vigorous that the digestive fire should be damped down in order to ensure the economical use of food. . . . For, to express the problem in another way, it may be said that we render food by preparation as capable as possible of being completely exhausted of its nutrient properties; and, on the other hand, to prevent the nutrient matter from being wastefully hurried through the body we make use of agents which abate the speed of digestion. A slow digestion is quite a different thing from an imperfect digestion ; indeed, it has seemed to me that dyspeptics sometimes suffer not from a too slow but from a too hurried digestion."

How often should Food be Taken?

The frequency with which meals should be taken is a matter of importance. A judicious interval should be allowed to elapse between the periods of taking food, for the plain reason that the stomach and other digestive organs demand a certain amount of rest. A full meal takes from three to four hours before the work of the stomach alone is completed, and beyond this we have to allow for the additional work of the intestine. Possibly an average of five hours represents the interval which should be allowed to elapse between meals. If the chief meal is taken in the evening, a light meal will suffice at midday, assuming that breakfast is taken at 8 a.m. It is quite possible, of course, that the intervals between meals may be too prolonged. The digestive system is less able to deal with a full meal after a very long period of repose than after its normal rest.

In this chapter we have limited our attention to a few plain and simple rules for keeping the digestive organs in good working order. Many interesting questions connected with the food upon which it is the office of the digestive apparatus to operate will be discussed in the chapters that follow.

CHAPTER LXXXIII

THE SCIENCE OF FOOD

Food the Raw Material of Life—The Four Essential Elements of Life—Nitrogenous and Non-nitrogenous Foods—Proteins—Carbohydrates—Fats—Tissue Formation—Energy Production—Food as Fuel—Quantity of Fuel Required—The Food Element that Makes the Best Fuel—Do the Carbohydrates and Fats Produce Energy ?—Professor Chittenden's Investigations—Importance of His Conclusions.

THE Science of Food is the Cinderella of the sciences, kept in the kitchen by her haughty sisters, and permitted to aspire no higher than the *chef*, and yet really of long and interesting lineage.

Regarded from a broad standpoint, food is the raw material of life —the material that makes roses, and caterpillars, and microbes, and men ; and not only the material which makes them, but also the material which gives them their various energies. Regarded still more broadly, food is the link between the organic and inorganic, between the dead and the living.

The Raw Material of Life.

Let us look for a moment at food in its larger relationships. Man begins as a little speck of coherent particles called *molecules*, and to this little speck are added molecules from the mother's blood, and the heap grows and grows till finally it takes the form of an infant. The infant, again, gathers molecules from the mother's milk, and so develops and increases in size. The formation of the infant before birth is a matter of food, and the development of the infant after birth is still a matter of food, still a matter of amassing molecules.

The process is a great mystery. We cannot understand the working of the loom of life—we cannot understand how the primary particles (the so-called molecules) of the food are woven into the living tissues. And yet, though we cannot understand the mysterious process, we can see certain relationships between the food, which is the warp and woof of life, and the living tissues, which are the final web ; and these relationships are of both theoretical and practical interest.

When we analyse the living tissues, we find, to our surprise, that

all living things are made of the same elementary substances, and that though there are about eighty elements altogether—iron, lead, copper, silver, gold, and the rest — yet only four elements — carbon, hydrogen, oxygen, nitrogen—are essential to life. These four elements, then, must be considered the material of which all living tissues are composed, and, since the living tissues are woven of food, we may expect to find in food these same four elements. And so it is. In the substances known as food, carbon, hydrogen, oxygen, and nitrogen are invariably found. All food, whether oysters or apricots, turtle or caviare, *pâté de fois gras* or cheese, contains nothing of much value save this wonderful quartet. These are the elements we eat, and must eat if we are to live. These are the only four atoms that can dance the quadrille of life. The ancient gourmands used sometimes to grind pearls and to dissolve them in wine, and it is possible to dissolve gold and to drink it ; but not of pearls and gold can flesh be made, only of the famous four.

The Four Essential Elements of Life.

This accordingly is the first great fact of dietetics—that food must supply carbon, hydrogen, oxygen, and nitrogen.

When we look into the matter farther, we find that there are in food two main classes of nutrient material—one class containing only carbon, hydrogen, and oxygen ; the other containing not only carbon, hydrogen, and oxygen, but also nitrogen. The nutrient material which contains nitrogen is known as *protein*, and that which contains no nitrogen as *carbohydrates* and *fats ;* and each material plays a characteristic part in general nutrition.

Nitrogenous and Non-nitrogenous Foods.

Nitrogenous foods have the power both of building tissues and of producing energy ; while non-nitrogenous foods can only produce energy, and, owing to their lack of nitrogen, cannot form living tissues.

In food as generally eaten, nitrogenous and non-nitrogenous materials are combined in various proportions. Thus meat, and bread, and rice, and peas, and potatoes, and peaches, and nuts contain both kinds of material. But at present we shall consider separately the separate part played by each material in the nourishment of the body.

Some proteins are animal and some vegetable, and they differ a good deal in their chemical constitution ; but all contain nitrogen, all can be a source of energy, and all go to the formation and repair of living tissues.

Proteins.

A pure form of protein is seen in the white of egg. Out of this protein, as is well known, the tissues of the chicken are built, and it serves equally well to make the muscles of a man. Lean of meat and Plasmon also consist almost entirely of pure protein.

Carbohydrates.

The carbohydrates include sugars and starches, and are almost entirely of vegetable origin. Wheat bread contains 57 per cent. of carbohydrate. Bananas are almost entirely made up of water and starch. Arrowroot, sago, tapioca, are also almost wholly starch. Sugar is found in the sugar-cane, in grapes, in beet, in the blood, and milk, and muscles, etc. All carbohydrates are readily combustible in the body, and are thus a source of energy.

Fats.

Fat occurs both in the animal and in the vegetable kingdom, and being even more combustible than carbohydrates, it is an even more potent source of energy. Both carbohydrates and fats, as we have seen, are non-nitrogenous, and cannot therefore make or repair the nitrogenous tissues of the body.

These, then, are the raw materials of the body. Let us now look at the manner in which each is rendered available for vital purposes by the chemical and physical processes of digestion.

The digestive canal has been compared to a chemical factory, where the food-stuffs are subjected to chemical processes. The chemical processes take place in the mouth, in the stomach, and all the way down the intestine, and vary with the material they treat.

The subject of digestion has already been dealt with in these pages, but we may here point out that the result of the whole series of processes is as follows: (1) The proteins are converted into certain soluble substances known as *peptones* and *amino acids*, which go to the formation and repair of the tissues, or which may be burnt up and used as a source of energy. (2) The carbohydrates are converted into absorbable sugar known as *dextrose*, which is a potential source of energy. (3) The fats are broken up into glycerine and fatty acids, are absorbed by the lacteals and lymphatics, and become a potential source of energy.

Let us now look for a moment at the two great functions of food, *tissue formation* and *energy production*.

All energy means and involves the disruption of the living tissues, and the *débris* of the tissues can be found in the excreta of the body in the form of fragmentary nitrogenous substances such as urea and uric

acid, and from the amount of nitrogen in the excreta it is possible to estimate how much waste of tissue there has been, and how much protein food must be taken to repair the waste. But the estimation is not quite simple, since part of the nitrogenous waste is derived not from broken down nitrogenous *tissues*, but from broken-down nitrogenous *food*. By starving a man, however, we simplify the problem, for if a man be taking no nitrogenous food, then all the nitrogen he excretes must be derived from his tissues. On making the experiment, it has been found that after a few days' fasting the loss of nitrogen, in a man leading an idle life, is about 5 grams a day. It might be thought, accordingly, that food containing 5 grams of nitrogen would be sufficient to repair the destruction of the tissues and to establish what is called "nitrogenous equilibrium." But this is not so. If a man be given enough protein food to supply 5 grams of nitrogen a day, he immediately begins to excrete more than 5 grams a day. This is probably due to the fact that part of the food is itself excreted, and that protein food stimulates tissue changes. Whatever the reason, the fact remains that more than 5 grams of nitrogen are required to maintain the nitrogenous balance.

Tissue Formation.

How much protein, then, is required? The ordinary man, on mixed diet, doing an average amount of work, excretes about 20 grams of nitrogen daily and consumes a corresponding amount—*i.e.* 125 grams—of protein food, the amount contained in twenty eggs or 1¼ pounds of meat; and up to quite recently this amount of protein food was considered necessary. Dr. Hutchison, for instance, who is a great authority on diet, laid down the dictum that the daily consumption of protein should never be allowed to sink below 100 grams, and should preferably be 125 (4½ ounces). During the last few years, however, Professor Chittenden, of Yale, has been carrying out experiments with regard to the amount of protein required in diet, and has found that a much smaller amount than has ordinarily been supposed necessary will suffice to keep the body in a condition of health and of nitrogenous equilibrium, provided always sufficient carbohydrate is added to the food to supply material for *energy*. We will deal later, in more detail, with Professor Chittenden's results. Meanwhile, we will merely state that his experiments seem to prove that 9 grams of nitrogen a day—*i.e.* 56 grams of protein—will suffice to maintain health and energy, even when expenditure of energy is considerable.

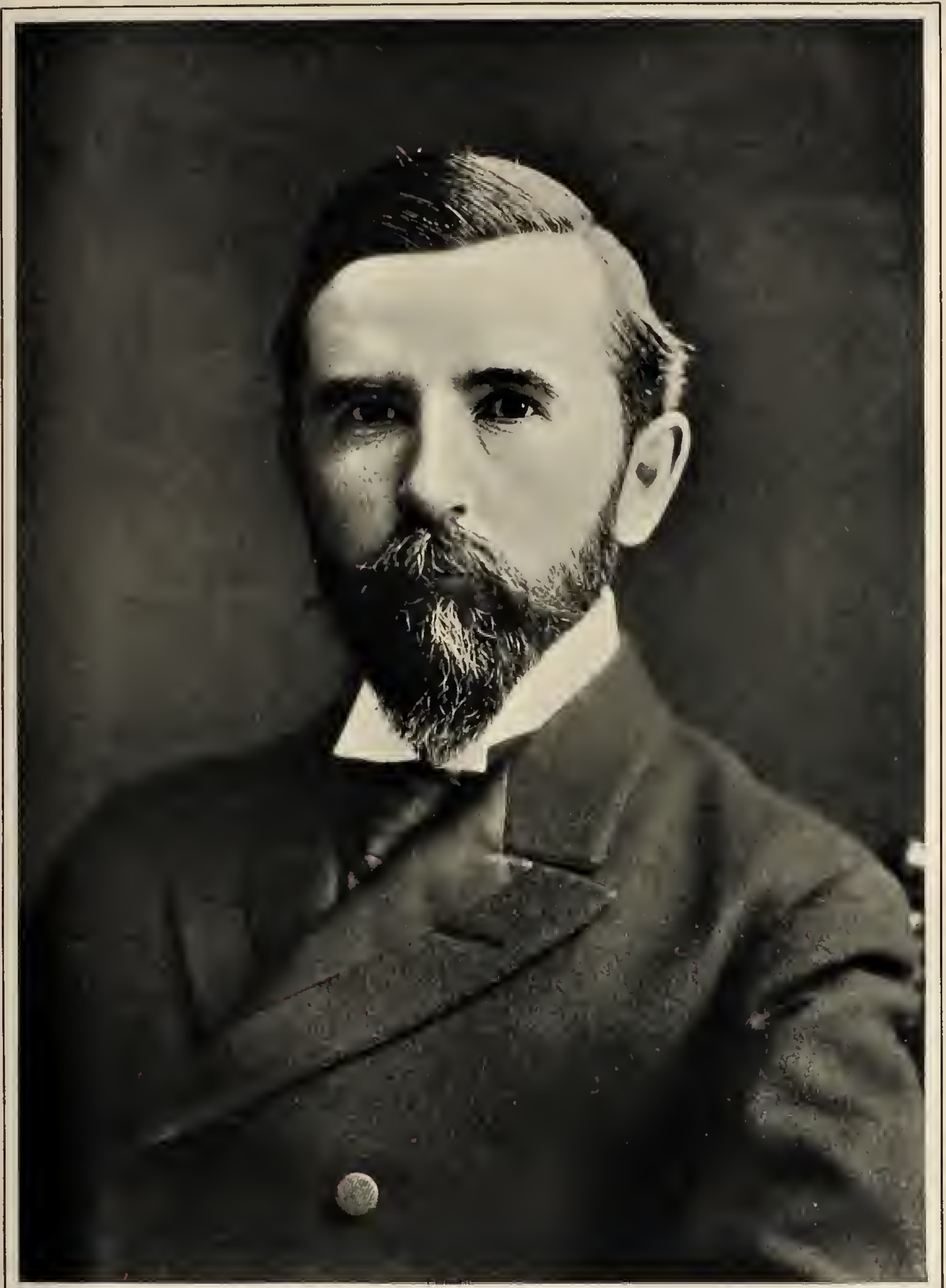
Energy Production.

All the energy of the body is produced by combustion of food, and, as we have seen, protein, carbohydrates, and fats are all combustible, and all, therefore, potential sources of energy. Since, too, all heat is convertible into work, it is possible to estimate the work-value of the food materials by estimating the amount of heat produced by their combustion. The unit of heat is known as a "calorie"—either a "small calorie" or a "large calorie." A small calorie is the amount of heat required to raise 1 gram of water 1° C. A large calorie is the amount of heat required to raise 1 kilogram (1,000 grams) 1° C. A large calorie is usually distinguished from a small calorie by being spelt with a capital letter, Calorie.

The energy value of the three foodstuffs expressed in Calories is found to be as follows :—

1 gram of protein	=	4·1 Calories
1 gram of carbohydrate	=	4·1 ,,
1 gram of fat	=	9·3 ,,

In other words, the energy value of fat, taken as a food, is more than double the energy value of protein and carbohydrate taken as a food. This is quite in keeping with the fact that we could boil about twice as much water by burning 1 pound of butter as by burning 1 pound of meat or bread. It is a question of combustion, and the amount of heat generated by combustion in the body is exactly the same as the amount of heat produced by ordinary combustion outside the body. The law of the transmutability and equivalence of heat and energy is at first sight very difficult to believe; but it is none the less true, and every action of the human body can be expressed in terms of heat. Tyndall cites the instances given by Dr. Mayer, one of the earliest workers at the subject: "A bowler who imparts a velocity of 30 feet to an 8-pound ball consumes in the act $\frac{1}{10}$ grain carbon. The heat of the muscle is here distributed over the track of the ball, being developed there by mechanical friction. A man weighing 150 lb. consumes, in lifting his own body to a height of 8 feet, the heat of 1 grain of carbon. Jumping from this height the heat is restored. The consumption of 2 ounces 4 drachms 20 grains of carbon would place the same man on the summit of a mountain 10,000 feet high." So exactly can energy be measured in terms of heat, and so convertible are heat and energy.



PROFESSOR R. H. CHITTENDEN.

The body, indeed, works just on the same principles as any other engine; and food is essentially *fuel* which is burnt up by the oxygen in the blood, and is converted partly into heat and partly into work. A certain amount of the heat of combustion serves to keep the body at a more or less constant temperature, and a certain amount is converted into muscular and chemical energy. Regarded as an engine, the human body is the most economical engine known. It is true it can convert only one-sixth of its total fuel energy into work, and that the rest is more or less wasted as heat; but even so, it is more economical than the best steam engine, which is able to convert into work only one-eighth of its total fuel energy.

Food as Fuel.

We have already seen how much protein material is required in order to maintain and restore the nitrogenous tissues of the body, and the further question now presents itself: How much food-fuel is required to supply energy and warmth to the body? We must measure the food-fuel by the amount of heat it generates when burned, and the question comes to be: How many Calories are required to produce the various energies of the body. Even as we might ask how much coal we require to burn to make an engine work, so we ask how many loaves and other articles of food we require to burn to make the body work. We may try to answer the question by examining the dietaries of various individuals and classes of individuals, and by determining the fuel-value of the food. When we do this, we discover that there are great differences in the amount of food consumed (measured in Calories), and that the amount is determined almost as much by the caprices and income of the individual, as by the muscular work he performs. Thus we find that brickmakers in America, who have heavy work and big wages, consume food representing fuel-value of no less than 8,848 Calories daily; while miners in Germany, performing quite as severe labour, eat only half as much. We find that American students eat twice as much food (measured in fuel-value) as is eaten by Japanese students, and we find many other discrepancies equally striking, between fuel burnt and work done. The question is of great importance, both from the standpoint of economics and from the standpoint of hygienics. From every point of view it is a mistake to use too much fuel—it is wasteful, and it wears out the engine. It is our duty "to find the minimum of steam that will run the engine, and then maintain a fire somewhat hotter than the exact

Quantity of Fuel Required.

requirement." We cannot, therefore, easily decide from ordinary dietaries how much fuel is really required, and though many dietetic investigations have been undertaken, the question is still more or less undecided, and authorities vary in the advice they give. One thing is certain, and that is, that the more the work, the more, in a general way, the fuel requisite for its performance, and the various standards suggested by various physiologists all make allowance for this obvious fact. The following daily standards are quoted by Dr. Hutchison in his admirable book on Food and Dietetics* :—

RUBNER'S STANDARD

Rest (*e.g.* clerk at a desk)	2,500	Calories
Professional work (*e.g.* a doctor)	2,631	,,
Moderate muscular work (*e.g.* a house-painter) ..	3,121	,,
Severe muscular work (*e.g.* a shoemaker)	3,659	,,
Hard labour (*e.g.* a blacksmith or navvy)	5,213	,,

ATWATER'S AMERICAN STANDARD *

Man without muscular work	2,700	Calories
Man with light muscular work	3,000	,,
Man with heavy muscular work	3,500	,,
Man with severe muscular work	4,500	,,

LYON PLAYFAIR'S STANDARD

Subsistence diet	2,102	Calories
Soldier (peace), light work	3,029	,,
Soldier (war), moderate work..	3,146	,,
Royal Engineers, moderate work	3,818	,,
Labourers, moderate work	3,611	,,
Average for moderate work	3,525	,,

Standards of this kind, based chiefly on the ordinary dietaries of mankind, have been in vogue for many years ; but recently they have been attacked from various quarters, and notably by Professor Chittenden, the American physiologist to whom we have already referred. "The standards," says this author, in his "Nutrition of Man,"† "which have been adopted more or less generally through the civilised world, based primarily on the assumption that man instinctively and

* "Food and the Principles of Dietetics," by Robert Hutchison, M.D.Edin., F.R.C.P. 1906. (Edward Arnold).

† "The Nutrition of Man," by R. H. Chittenden. 1907. (Wm. Heinemann.) Based upon the dietetic habits of over 15,000 persons.

independently selects a diet that is best adapted to his individual needs, are open to grave suspicion. The view that the average food consumption of large numbers of individuals and communities must represent the true nutritive requirements of the people is equally untenable . . . We are inclined to the belief that direct physiological experimentation, covering a sufficient length of time and with an adequate number of individuals, will prove far more efficient in affording a true estimate of the quality and quantity of food best adapted for the maintenance of good health, strength, and vigour." Proceeding on this assumption, Professor Chittenden has proved by a series of interesting experiments that the amount of fuel required by the body is much less than that indicated by the standards we have quoted, and that even for hard muscular work a healthy man of 11 stone weight requires, at the outside, food of a fuel-value of only 3,000 Calories.

Which Food-element makes the Best Fuel?

Granting, then, that an 11-stone man requires food of a fuel-value of 3,000 Calories, we have next to see which constituent of food makes the best fuel. We can set an engine going by burning either wood or coal, or other substances, and we can supply fuel to the body as food of various kinds. When we talk of food of the fuel-value of 3,000 Calories, we mean, as has been explained, simply food which will produce, during combustion, sufficient heat to raise 3,000 kilograms or litres of water 1° C. (or, put otherwise, 3,000 pints of water 4° F.). Now we can heat the water equally well by burning loaves (mainly carbohydrates), or meat (mainly proteins), or fats ; and we can supply the body with the requisite amount of heat (3,000 Calories) to provide energy and warmth, by eating and burning within the body any of these. But which is best ? As we have seen, 1 gram of carbohydrate (starches and sugars) and 1 gram of protein (*e.g.* albumen of egg) produce, when burnt, enough heat to produce each 4.1 Calories, whereas 1 gram of fat when burnt produces 9.3 Calories. It would seem accordingly that we may produce the necessary flame of life (3,000 Calories in value) equally well by consuming about 700 grams of protein or starch, or about 300 grams of fat. The white of one egg, a small lump of sugar, and a thimbleful of olive oil will all produce the same heat (about 17 Calories) when burnt, and will therefore be of equal value as sources of bodily energy. The whites of fifteen or twenty eggs, fifteen or twenty lumps of sugar, or a few teaspoonfuls of oil, will equally suffice to keep

the lamp of life alight. Again, which is best ? Both inside and outside the body fat or oil is the best fuel—*i.e.* produces more heat in proportion to its weight than the other two ; we use it for our lamps and candles, and it might seem wise to use it also for the furnaces of our bodies. But the question of food-fuel is not quite so simple, and in deciding what fuel to use, *many* things have to be considered. We have to consider whether the fuel burns with difficulty or with ease. We have to consider whether it burns completely away or leaves ashes. We have to consider its effects on the complicated mechanism of the body. We have to consider the space it occupies, and the price it costs, and many other facts.

In one respect protein is the best fuel. It is the best fuel, in that it is both firewood and building timber. It both builds up the tissues and can be burnt as a source of energy, and without it we cannot live. " We may be deprived of starches and yet live ; we may be deprived of sugars and yet live ; we may go without fats ; but unless we have protein we die " (Gamgee). Yet even protein has its disadvantages. It is costly. It leaves ashes (*e.g.* uric acid) which choke the furnace of life, and it is apt to overwork the kidneys. Further, when attempts are made to feed exclusively on protein, the stomach rebels. Moreover, its caloric value is comparatively small, and in order to obtain 3,000 Calories of energy (approximately the amount required), a man of 11 stone weight would require to consume daily nearly 5 pounds of lean beef.

Fat, as we have seen, has great combustion value ; but in the body it is not readily burnt, and most people find it difficult to digest ; while in excessive amounts it is apt to be deposited in the tissues to the detriment of the organism.

Carbohydrates (starches and sugars) are probably the most valuable source of energy pure and simple ; but, like fats, they tend, when taken in excess, to produce corpulence.

Life and energy cannot be maintained on any one of the three constituents of food, and all authorities are agreed that all three constituents should be combined in the diet. Differences of opinion arise only when an attempt is made to determine the right proportion of each, the best source of each, and the part each ought to play in the production of energy. Dr. Hutchison, in the work already cited, gives the following table, showing the proportions fixed by various authorities :—

Authority	*Protein*	*Fat*	*Carbohydrates*	*Calories*
Munk	105	56	500	3,022
Wolff	125	35	540	3,030
Voit	118	56	500	3,055
Rubner	127	52	509	3,092
Playfair	119	51	531	3,140
Moleshott	130	40	550	3,160
Atwater	125	125	450	3,520
AVERAGE ..	121	59	510	3,135

We see that there is a comparative agreement between these authorities, but still the question is far from settled, and at present other standards are gaining ground. Difference of opinion is centred round the question of the part played by proteins in the production of energy. The great chemist Liebig was of the opinion that most of the muscular energy of the body was produced by the combustion of proteins, and that the combustion of carbohydrates and fats went largely to maintain the bodily temperature; and this opinion was paramount for many years, and is still influential. We still find that many men, if not most civilised men, think it necessary to eat large quantities of meat if they are engaged in violent muscular exercise, and that the idea is prevalent that a flesh diet increases muscular power. Even among certain scientific men the idea still prevails. Dr. Haig, a well known writer on dietetics, in his book "Diet and Food," argues that sugar, and starch, and oil are of no importance for the production of force, and that the main source of force is protein food, and that, indeed, the sum of energy generated by the body can be best calculated by estimating the ashes (urea, etc). of the proteins that have been burnt. He accordingly reduces the science of dietetics to the questions how many grains of protein will be required per day, for nutrition and production of force, and in what form it is best administered. He concludes that vegetable proteins are best, and that, in a general way, if we multiply a man's weight in pounds by 9 or 9.5 we get the number of grains of protein material required for sedentary or for active life. Thus, if a man weigh 130 pounds he will require for sedentary life 130 × 9, or 1,170 grains

Do the Carbohydrates and Fats produce Energy?

of protein a day; and for active life, 130 × 9.5, or 1,365 grains of protein a day. The quantity of protein he gives is not greater, rather less, than the quantity estimated in the table we have quoted, and Dr. Haig's heresy lies not in the amount of protein he prescribes, but in the importance he attributes to it as the main producer of energy, and in the importance he attaches to the quality of the protein. At present, however, he is very much as a voice crying in the wilderness, for the trend of physiological opinion is all in the opposite direction, and Chittenden's experiments have shown that life can be supported and energy produced by very small amounts of protein, provided the food has, in other respects, sufficient calorific value.

Chittenden's Investigations.

Chittenden contends that life can be supported, and energy maintained, upon half the amount of protein recommended in the tables we have quoted, and he maintains that protein should be used only for the purpose of maintaining the integrity of the tissues, and that for the production of energy carbohydrates and fats should be exclusively used. He holds that the proteins are not wholly combustible, and that they have to be split up before they are burnt, and this involves useless labour. "It requires no argument, however," he says, "to convince one that such a procedure (the use of proteins as fuel) for the normal individual is less economical physiologically than a direct utilisation of carbohydrate and fat, introduced as such and duly incorporated with the muscle substance. Consequently, in the nourishment of the body for vigorous muscular work, there is reason in a diet which shall provide an abundance of carbohydrate and fat; protein being added thereto only in amounts sufficient to meet the ordinary requirements of the body for nitrogen, and to furnish, it may be, proper pabulum for the development of flesh muscle fibres, whereas in training effort is being made to strengthen the muscle tissue and so enable it to do more work. Increase in protein food may help to make new tissue, but the source of the energy of muscle work is to be found mainly in the breaking down of the non-nitrogenous materials, carbohydrate and fat."

Chittenden supported his contention by means of practical experiments on men and animals. He took groups of subjects and gave them dietaries containing about half only the amount of protein food usually considered necessary, and showed that even with such a small quantity of nitrogenous material the income was equal output of nitrogen and

the tissues maintained in their integrity. He showed further that, provided a sufficiency of fuel in the form of carbohydrate and fat was given, the subjects improved in health, and increased in muscular strength, and that "a reduced protein diet is equally as effective with vigorous athletes accustomed to strenuous muscular effort, as with professional men of more sedentary habits."

In one case Chittenden experimented with men of the Hospital Corps of the United States Army. They were given on the average about 56 grams of protein (about one-half of the amount usually considered necessary, and about one-third of the amount they were accustomed to take in ordinary life), and the fuel-value of the whole food did not reach 3,000 Calories per day. Yet they lived without discomfort and lost little or any weight; while they greatly increased in strength, as the following table, taken from Chittenden's "Nutrition of Man," will show:—

RESULTS OF CHITTENDEN'S DIETARY

Total Strength			Total Strength		
	October	*April*		*October*	*April*
Broyles	2,560	5,530	Morris	2,543	4,869
Coffman	2,835	6,269	Oakman	3,445	5,055
Cohn	2,210	4,002	Sliney	3,245	5,307
Fritz	2,504	5,178	Steltr	2,838	4,581
Henderson	2,970	4,598	Zooman	3,070	5,457
Loewenthal . ..	2,463	5,277			

Not only strength, but also power of endurance was increased by reducing the protein supply.

Chittenden concludes from his various experiments that a man requires 0·85 gram of protein per kilogram of weight, or about 5 grains per pound of body-weight. "Hence for a man weighing 70 kilograms, or 154 pounds, there would be required daily 59·5—say 60 grams (about 930 grains)—of protein food to meet the true wants of the body. It will be observed," continues Chittenden, "that such an intake of protein food daily is equal to one-half the Voit standard for a man of this weight, while it is still further below the Atwater standard, and far

below the common practices of the majority of mankind in Europe and America, as indicated by the published dietary studies."

To most people 60 grams of protein conveys no precise significance, and a more definite idea of the amount may be obtained by expressing it in terms of actual food. Thus, 60 grams of protein are contained in ½ pound of lean beef, in nine hens' eggs, in ½ pound of American pale cheese, in 1 pound of uncooked macaroni, in 1⅓ pound of white wheat bread, in ½ pound of dried peas, in 10 lbs. of bananas, in 33 lbs. of apples.

If Professor Chittenden's conclusions are correct, the consequences are of great importance. "If it is true," he says, "that the demands of the body for protein food—which of all foods is the most expensive—are fully met by an amount equal to one-half that ordinarily consumed, and that health and strength are more satisfactorily maintained thereby, it is easy to see how the acquisition of dietary habits leading to consumption of food in harmony with physiological needs will result in a fruitful twofold harmony—viz. economy in expenditure and, of still greater moment, economy in the activities of the body by which food and its waste products are cared for."

Importance of his Conclusions.

It may turn out that Chittenden's conclusions go a little too far, but we may sum up the present scientific position with regard to food as follows: An average man of 11 stone weight maintains health and energy best on a mixed diet containing about 60 grams (a little over 2 ounces) of protein, and as much carbohydrate and fat as will bring the total fuel-value of the food up to about 2,800 or 3,000 Calories. Of course, allowance must be made for age, build, temperament, climate, and other circumstances.

CHAPTER LXXXIV

SOME PRACTICAL QUESTIONS CONNECTED WITH FOOD

Fuel-value of Different Foods—A Doctor's Personal Experience of a Minimum Diet—Modern Feeding—The Fear of Fat—Absorbability of Food—Expenditure of Energy—Bulk of Food—Consistency of Food—Number of Meals—Appetite, and how to Stimulate it—Cooking of Food—Methods of Preserving it.

Fuel-value of Different Foods.

So far, we have been dealing with the three constituents of food, but these three constituents do not usually occur separately in natural foods; and ordinary dietaries contain them combined in articles of food in definite proportions. This naturally renders the due proportioning of proteins, carbohydrates, and fat more difficult. Some foods have high fuel-value but are deficient in protein; others are deficient in fuel-value but contain abundance of protein. Thus 1 pound of butter contains more than 3,500 Calories of potential energy but almost no protein; while 1 pound of lean beef, which is chiefly protein, has a fuel-value of only 600 Calories. A pound of cheese, again, contains a large proportion of protein, but has fuel-value of only 1,300 Calories.

We might depend on 1 pound of butter for energy, but 1 pound of butter would not suffice to repair tissue waste. We might repair tissue waste with 1 pound of lean meat; but 1 pound of meat would not provide sufficient energy to keep the body going. A pound of cheese contains much more protein than the tissues require; but it would require more than 2 pounds of cheese to supply fuel for muscular energy. The moral of all this obviously is that we must combine articles of food in our dietary in such a way that together they contain about 60 grams of protein for the tissues, and 3,000 Calories of fuel-value for the production of energy. Before, however, discussing such combinations, let us glance at the fuel-value, and at the constitution as regards proteins, carbohydrates, and fat, of various articles of food in common use. We

take our figures from the table given by Professor Chittenden, prepared from data derived from a bulletin of the United States Department of Agriculture.

CHEMICAL COMPOSITION AND FUEL-VALUE OF SOME COMMON FOOD MATERIALS.

Food Materials	*Protein*	*Carbo-hydrates*	*Fat*	*Water*	*Mineral Matter*	*Fuel-value*
	per cent.	*per cent.*	*per cent.*	*per oent.*	*per cent.*	*per lb.*
Fresh beef, loin, lean, edible portion	24·2	0	3·7	70·8	1·3	615
Cooked beef, roasted ..	22·3	0	28·6	48·2	1·3	1,620
Broiled tenderloin steak	23·5	0	20·4	54·8	1·2	1,300
Fresh leg of lamb, edible portion	19·2	0	16·5	63·9	1·1	1,055
Roast leg of lamb, edible portion	19·4	0	12·7	67·1	0·8	900
Roast leg of mutton, edible portion	25·9	0	22·6	50·9	1·2	1,420
Smoked ham fat, edible portion	14·8	0	52·3	27·9	3·7	2,485
Roast turkey, edible portion	27·8	0	18·4	52·0	1·2	1,295
Fresh cod, dressed ..	11·1	0	0·2	58·5	0.8	215
Boiled hens' eggs	13·2	0	12·0	73·2	0·8	765
Butter	1·0	0	85·0	11·0	3·0	3,605
Whole cow's milk.. ..	3·3	5·0	4·0	87·0	0·7	325
Oatmeal	16·1	67·5	7·2	7·3	1·5	1,860
Rice	8·0	79·0	0·3	12·3	0·4	1,630
Wheat flour, entire wheat	13·8	71·9	1·9	11·4	1·0	1,675
Boiled rice	2·8	24.4	0·1	72·5	0·2	525
Brown bread	5·4	47·1	1·8	43·6	2·1	1,050
Custard pie	4·2	26·1	6·3	62·4	1.0	830
Green peas	7·7	16·9	0·5	74·6	1·0	465
Boiled potatoes	2·5	20·9	0·1	75·5	1·0	440
Almonds, edible portion .	21·0	17·3	54·9	4·8	2·0	3,030
Peanuts, edible portion	25·8	24·4	38·6	9·2	2·0	2,560
Pine nuts, edible portion	33·9	6·9	49·4	6·4	3·4	2,845
Brazil nuts, edible portion	17·0	7·0	66·8	5·3	3·9	3,265

When we glance at the above table we notice two or three outstanding features. We notice that all the animal foods, except milk, are wanting in carbohydrates, and that most of the vegetables, except nuts, are deficient in proteins. We notice, too, that most foods contain a fair

DIAGRAMMATIC REPRESENTATION OF THE FUEL-VALUE AND CHIEF CHEMICAL ELEMENTS OF SOME COMMON FOODS (*see Table on page 120*)

THE FUEL-VALUE IS REPRESENTED IN THE TABLE IN CALORIES; THE PROTEID, CARBOHYDRATES AND FAT IN PERCENTAGES.

proportion of fat, but that fat is rather deficient in wheat. The rough lesson of these facts obviously is that we should combine animal and vegetable foods, and should add fat to wheat; and the instincts of humanity, without understanding *why*, usually do so. We take bread and potatoes with our meat, and we spread butter on our bread, and we take milk or cream with our porridge.

We can provide 60 grams of protein and 3,000 Calories of fuel energy by various combinations, though exactitude in amount is neither necessary nor desirable. Thus, ½ pound of beef, ½ pound of butter, ½ pound of potatoes, and ½ pound of bread will approximate the standard. Two eggs, 2 pints of milk, ½ pound of bread, ½ pound of potatoes, 4 ounces of butter, and 4 ounces of sugar, would do equally well. Or we might take all the protein required as eggs (nine of them), or as milk protein, such as "Protene," and then add fuel, as required, in the form of starchy foods, and sugars, and fats.

Within the limits of Chittenden's dietary, there is room for plenty of variation in diet. Nor, if we take a wide view of diet, is it very revolutionary. The Japanese, who are notable for their health and for their mental and physical vigour, have always consumed a relatively small amount of protein—probably, in most cases, less than 60 grams a day; and other Eastern peoples equally vigorous consume equally small quantities of protein. In the Japanese army, however, it is interesting to note that a ration has been fixed containing about 150 grams of protein, and having a fuel-value of more than 3,000 Calories. It is curious that as Western nations are beginning to diminish the protein in their diet the Japanese should go in the opposite direction.

In the *British Medical Journal* of April 7th, 1906, a medical man gave an interesting account of his own experience:

A Doctor's Personal Experience.

"I determined to give the minimum of protein diet a fair trial in my own case. The result was that I was relieved of a life-long tendency to acid dyspepsia and occasional sick-headache; my fitness for work, my appetite and relish for food, were increased, without any diminution, but rather a slight increase, in my weight. My practice extends over a wide area of rough, mountainous country, involving long journeys on cycle, on foot, driving, and in open boats, in fair and foul weather. The muscular exertion and endurance necessary for the work would seem to require a large proportion of protein and

a generous diet altogether; but since I began to experiment I have suffered less than formerly from fatigue, and seem to eat in all a smaller quantity of food. My diet consists of:

"*Breakfast*, 8.30 a.m.—Oatmeal cakes, bread-and-butter, about 1 cubic inch of cheese or bloater paste, marmalade, and one breakfast cup of tea.

"*Lunch*, 1.30 p.m.—Same as breakfast, with occasionally a boiled egg, and sometimes coffee instead of tea.

"*Dinner*, 7 p.m.—Thick soup, containing vegetables, with bread, followed by suet pudding or fruit tart; or vegetable stew, containing 2 or 3 ounces of meat, with boiled potatoes, followed by milk pudding and jam, and occasionally a cup of black coffee."

Under-feeding.

A reduced protein diet, accordingly, would seem to be correct in theory and possible in practice, and to be followed in most cases by an increase in efficiency. Nevertheless, the public must be warned against extreme or ignorant interpretations of Chittenden's dietary recommendations. In the first place, it should be clearly understood that there is such a thing as underfeeding as well as overfeeding; and that, though it may be well to cut down protein food by half, it would be extremely unwise in most cases to cut down carbohydrates in like proportion; in many cases, indeed, a reduction in meat should be associated with an increase in bread and potatoes. A mere reduction of protein or of diet in general is just as likely to work harm as good unless the reduction be judicious and based on an understanding of the principles of feeding. It is probable that more people starve themselves with regard either to protein or carbohydrates, or to both, than exceed with regard to proteins, and the deficit may be quite as dangerous as the excess. No one should live quite from hand to mouth, and there is not much advantage in having a furnace free from protein ash, if there be insufficient fuel to generate steam. It must be remembered, too, that the body is a somewhat variable engine, and that one man may need more fuel than another in order to do the same work. A considerable proportion of the heat, as we have seen, goes to maintain the temperature of the body, and the amount necessary for this purpose must vary in no small degree, with the superficies of the body, with its ordinary temperature (which differs to some extent in different individuals), with the clothing worn, with the conductivity and moistness of the skin, with the external temperature, with the

moisture in the air, with temperament, and with sundry other circumstances.

It must be pointed out, further, that a man's energy is not to be measured solely by his muscular output: he is also an emotional and intellectual animal, and a diet which may result in most satisfactory muscular performances *may* also result in emotional and moral deterioration. The effect of a good dinner on a man's views of life is well known. The effect of hunger in arousing the lower animal instincts of a man is equally well known. And food must be considered not merely as fuel for a fire or as timber for a building, but also as a stimulant of the higher faculties. The underfed are often not only physically but also morally weak.

The Fear of Fat.

It is fashionable nowadays to fear fat; but fat in its place is a very good thing, and any dietary that tends to remove all fat from the body is undoubtedly injurious. Fat economises heat by preventing its too rapid radiation; and it also serves as fuel in times of emergency. All the muscles which are subject to prolonged and constant exercise have fat between their fibres. The diaphragm, for instance, is well supplied with fat, and in the human heart muscle there is normally enough fat to supply the heart with fuel for six or seven hours' work. Aspirations towards emaciation are therefore not to be encouraged.

Absorbability of Food.

In order to estimate the fuel-value of food or its capacity for making nitrogenous tissue, it is not enough to make an estimate of its chemical constituents: we must also investigate whether these are in a digestible and absorbable form. Almonds and pine-nuts, for instance, contain food stuffs in most concentrated form, but they are not, therefore, more nourishing than such a dilute form of food as milk. In a general way, fats and carbohydrates are usually very completely absorbed; while in many cases a considerable portion of the protein remains unabsorbed. In beans, for instance, the protein unabsorbed amounts to 30 per cent., and in carrots and lentils to 40 per cent., of the whole amount present. Animal protein, however, is much better absorbed than vegetable protein, and in the case of eggs, meat, and fish absorption of the protein is almost complete. Vegetable proteins are less completely absorbed, not because less digestible, but because protected from the digestive juices by indigestible fibres of cellulose. On a mixed diet absorption is more

complete than when the food constituents are given singly, and this favourable action is seen especially in the case of proteins, probably because the carbohydrates form acids which prohibit the action of intestinal bacteria that would otherwise destroy the proteins.

Expenditure of Energy in Digestion.

In estimating the fuel-value of food there is still another circumstance which must be taken into account—there is the question of the amount of energy expended in digesting the food. It is obvious that the less energy expended in digesting the food the more valuable, *ceteris paribus*, will the food be. Professor Pawlow, a well known Russian physiologist, has made some valuable investigations bearing on this question. He has shown the very extraordinary fact that "each separate kind of food corresponds to a definite hourly rate of secretion, and calls forth a characteristic alteration of the properties of the juice." He has shown that "on protein in the form of bread, five times more pepsin (the digestive ferment of the stomach) is poured out than on the same quantity of protein in the form of milk," and that flesh nitrogen requires 25 per cent. more pepsin than that of milk. He has shown also that the same relationship holds with regard to the pancreatic juice—that bread protein demands more pancreatic ferment than meat protein, and meat protein more than milk protein. Consequently "the price which the organism pays for the nitrogen of milk, in the form of work on the part of its digestive apparatus, is much less than that for other foods."* In all cases in judging the fuel-value of a food, the price paid for it in digestive energy must be taken into account. Hence boiled and unboiled milk, though containing the same amount of nutritive material, and though equally absorbable, may have unequal nutritive value, since one may be more costly to digest than the other. So in the case of raw and of cooked meat, etc.

Bulk of Food.

There are people who look forward to the day when they will be able to carry their dinner in a pill-box; but that day will never come. The food stuffs necessary to maintain energy and repair the tissues cannot be compressed into a couple of tabloids, and it is not desirable that they should be. In certain cases it may be desirable not to overload the intestines, and to avoid the more bulky

* "The Work of the Digestive Glands." By J. P. Pawlow. 1902. (Charles Griffin and Co.)

vegetable foods, but, after all, there are some yards of intestines, and to offer them a couple of pills of starch and protein is to insult their capacity. In the first place, taste and mastication are essential to satisfactory chemical digestion, and in the second place, a certain bulk of food is desirable in order to stimulate the muscular action of the stomach and bowels. And it is not only desirable that the food eaten should have a certain considerable bulk, it is also desirable that a certain proportion of its bulk should be made up of indigestible, innutritious, and unabsorbable constituents, so that these constituents may act as a mechanical stimulus to the intestines. There can be no doubt at all that many cases of constipation are due to lack of mechanical stimulation, and all such cases can be benefited by adding to the diet articles of food, such as vegetables containing cellulose, which give rise to a sufficient amount of residue.

Consistency of Food: Mastication.

Not only should the food have a certain bulk, it should also have a certain consistency. The tendency so common in the present age —which has been called the "age of pap"—to take sloppy bland foods, which can be swallowed without chewing, is detrimental to the digestion. Tough food, it is true, requires mastication, but mastication is not waste energy, not merely unnecessary comminution; it is a valuable preliminary of digestion, and reflexly stimulates both the heart and the digestive secretions. Food that requires no mastication fails to promote this initial reflex stimulation, and in so far is dietetically deficient. The *taste* of food, indeed, seems largely for the purpose of encouraging chewing, and some physiologists recommend that food should be chewed and insalivated till it becomes tasteless and semi-liquid. A habit of thorough mastication seems to result in the education of a reflex in the throat (pharynx), which prevents the swallowing of unmasticated lumps of food.

Besides stimulating the heart and digestion, and rendering foods ordinarily considered indigestible quite digestible, chewing seems to increase the nutritive value of food and to render the excreta almost quite inoffensive.

At the instigation of two American scientists, special observations on the physiology of mastication were made at Cambridge in 1901, and Sir Michael Foster reported: "The adoption of the habit of thorough insalivation of the food was found in a consensus of opinion to have

an immediate and very striking effect upon appetite, making this more discriminating, and in particular reducing the craving for flesh food. The appetite, too, is beyond all question fully satisfied with a dietary considerably less in amount than with ordinary habits is demanded. . . . In two individuals who pushed the method to its limits, it was found that complete bodily efficiency was maintained for some weeks upon a dietary which had a total energy value of less than one-half of that usually taken, and comprised little more than one-third of the protein consumed by the average man. . . One fact, fully confirmed by the Cambridge observations, consists in the effects of the special habits described upon the waste products of the bowel. These are greatly reduced in amount, as might be expected ; but they are also markedly changed in character, becoming odourless and inoffensive, and assuming a condition which suggests that the intestine is in a healthier and more aseptic condition than is the case in ordinary circumstances."

Mr. Horace Fletcher found the nutritive properties of diet so increased by thorough insalivation that he lived on three eggs, 12 ounces of potatoes, and about 2 pints of milk with cream a day, and was able on this dietary to maintain his weight and energy, though playing six sets of tennis a day, or riding an hour and a half on horseback, with an hour to an hour and a half's walk or climb daily, in addition to much reading and writing.

One of the great disadvantages of a fluid or semi-fluid diet is that it does not call into play the mechanism of mastication ; and when it is necessary to prescribe fluid diet, the desirability of insalivation should be explained to the patient.

It must be remembered that primitive man was a non-cooking animal, and had to tear and munch his food, and even the modern stomach has to regard the conditions of its evolution. It may be pointed out, too, that the instinct to chew is still in evidence. Children love to chew things, and in lieu of anything better will chew pencils or indiarubber. The chewing-gum habit of the American is an example of the same instinct, and is shared by Australians and Patagonians.

Why we should nowadays fear to chew is difficult to understand ; but certainly everything is done to render mastication unnecessary. The infant is bottle-fed, and is debarred the masticatory exercise which breast feeding involves. The child is given food in the liquid or pultaceous form, such as rusks soaked in milk, puddings, and mashed

potatoes, and it is said that adenoids are thus caused by deficient exercise of the muscles of mastication. The adult is given the tenderest meat and the most superfine bread. All this is obviously wrong, and though the results may not be quite so disastrous as certain writers aver, yet they are certainly bad, and an effort should be made to teach the public wiser habits.

Dr. Harry Campbell advises that the child should make its first acquaintance with starch, not in the form of soft, pappy food, but in the form of well-baked crusts, and he advises that loaves should be made in such a way as to have a maximum of crust and a minimum of crumb; and he also suggests that crusts, stale bread, stale cake, and biscuits should be more eaten.

Mr. Horace Fletcher, in his well known book "The A B Z of Nutrition," gives the following counsel: "Chew, masticate, munch, bite, taste, everything you take in your mouth (except water, *which has no taste*) until it is not only thoroughly liquefied and made neutral or alkaline by saliva, but until the reduced substance all settles back in the (glosso-epiglottidean) folds at the back of the mouth and excites the swallowing impulse into a strong inclination to swallow. Then swallow what has collected and has excited the impulse, and continue to chew at the remainder, liquid though it be, until the last morsel disappears in response to the swallowing impulse. Never forcibly swallow anything that the instincts connected with the mouth show any disposition to reject. It is safer to get rid of it beforehand than to risk putting it into the stomach. Sip and taste milk, that is, taste as the wine-tasters do. They never drink wine, and yet they get all the enjoyment there is in it and waste none. In a very short time sipping and tasting liquids and masticating and tasting solid food for all they are worth will become an agreeable and profitable fixed habit." These are obviously the words of an enthusiast, but the principle is sound.

Number of Meals.

On no question is there more difference of opinion than on the question of the number of meals which ought to be taken. Probably no general law can be laid down further than that, as we have said in an earlier chapter, about five hours should intervene between meals, and that, on vegetarian diet, the interval should be longer than on mixed diet. In cases, of course, where only small quantities of food can be given at a time, feeding must be more frequent. The modern institution of afternoon tea between lunch and dinner is probably an unmixed evil.

It may be asked, Is not the appetite a trustworthy guide, at once to the character and the amount of the food required? Is it not the case that a man with a good appetite requires more food than a man with a poor one? To these questions negative answers must be given. The appetite is very rarely a trustworthy guide, as regards either the quantity or quality of food desirable. Under the artificial conditions of modern cuisine, the appetite is wheedled and coaxed, or curbed and denied, till it ceases altogether to be any indication of the real physiological wants of the system. The gourmand perverts his appetite with piquant sauces, and tempts it with tasty dishes, till it does not know when it has had enough. The ascetic denies himself till the craving ceases to worry him. The man with a really healthy physiological appetite proportioned to the needs of his system is nowadays a *rara avis*. Still, even a vitiated appetite may be trained to be a mentor and monitor to the digestive organs, and Professor Chittenden states that after diet has for some time been apportioned to physiological requirements, the appetite begins to demand just the right quantity. The advocates of mastication, too, declare that when food is duly insalivated satisfaction and satiety are felt when sufficient has been eaten. "Owing," says Mr. Horace Fletcher, "to deliberation in eating necessitated by this new habit (of thorough mastication), satiety occurs on the ingestion of considerably less food. By carefully studying oneself, I believe it possible to cultivate an instinct which will regulate not only the quantity but the quality of food that the body may need, and that in the *normal health* of a full-grown body, no more food, either in quantity or quality, should be supplied than suffices to supply diurnal waste."

Appetite.

An appetite so exemplary as this hardly comes into the sphere of practical dietetics; but still appetite, *quâ* appetite, must always be of the greatest importance in the due performance of the digestive functions. For some years there was a tendency to belittle appetite in all respects. It was considered not only untrustworthy, but also unnecessary. The experimental work of Pawlow, however, has quite established the physiological value of appetite, and it is now recognised to be an essential preliminary of normal digestion.

As is well known, appetising food "makes the mouth water" even before it is tasted, and not only does the mouth water, but, so to speak, the stomach also "waters." Pawlow teased a dog by offering it meat

without permitting it to take the food, and showed that the result was a copious secretion of gastric juice. "The meaning of this experiment," says Pawlow, in the work already cited, "is so clear as to require no explanation; the passionate longing for food, and this alone, has called forth under our eyes a most intense activity of the gastric glands. If the experiment be frequently repeated, one can easily observe that the keener and more eager the desire on the part of the dog for the food, the more certain and intense is the secretory effect. We are therefore justified in saying that the appetite is the first and mightiest exciter of the secretory nerves of the stomach, a factor which embodies in itself a something capable of impelling the empty stomach of the dog in the sham feeding experiment to secrete large quantities of the strongest juice. A good appetite in eating is equivalent from the outset to a vigorous secretion of the strongest juice; where there is no appetite this juice is also absent. To restore appetite to a man means to secure him a large stock of gastric juice wherewith to begin the digestion of the meal."

It is sometimes said that appetite comes with eating, and there is a good deal of truth in the saying. The sight, odour, and taste of the food do stimulate appetite, even when it has been quite absent at the commencement of the meal. Complete mastication, by making the most of the taste and the smell of the food, has thus an additional advantage. On the other hand, it is probably a mistake to force food down when the appetite is lacking, since it has been proved that in the absence of appetite juice the mere presence of food in the stomach is not a sufficient stimulus of the gastric secretion. Pawlow showed that when food was introduced into the stomach of a dog without a dog's knowledge the secretion of gastric juice was either very scanty or *nil.*

How to Stimulate Appetite.

Seeing, then, the importance of appetite, the question at once arises, How can it be best acquired? In health, under normal conditions, it is probably always present; but when health is impaired, and under the artificial conditions of civilised life, it often fails and flags. In general, the best way to improve appetite is to improve the health, and especially to improve the blast of the furnace of the body. With an increase of breathing capacity, which means an increase of burning capacity, there is usually an increased appetite for food as fuel, and accordingly singers have often unusually large appetites. Exercise in the open air notably increases appetite, and the increase is due more to the open air than to the exercise.

An experiment was once made at a dinner at a restaurant in London. The dining-room, unknown to the guests, was specially ventilated, so that the air was kept perfectly pure. The result was that the guests ate more per head than had ever been eaten at that restaurant before.

Even health, open air, and exercise, however, are not always sufficient to provoke appetite. We have seen that when food is put into a dog's stomach without the dog's knowledge, digestion is rendered much less efficient. Just in the same way, if food be gulped down or eaten inattentively, appetite is lacking and digestion retarded. Hence the bad effects on the appetite and digestion of sorrow and worry. Hence, too, the bad effects of reading at meals.

George Herbert, the poet, recommends that we should eat our food with the thought, "Dust to dust we commit." Thoreau, when asked at dinner which dish he would prefer, was wont to answer, "The *nearest*." Nothing could be a greater mistake. To eat in such a spirit is to court dyspepsia.

On sitting down to a meal the senses of sight and smell and taste should be concentrated on the food, and all gloomy thoughts should be so far as possible banished. Many people notice that they can eat better in company, especially in good company, than by themselves; the reason being that lively conversation diverts the thoughts from worrying subjects. Wine that maketh glad the heart of man also thereby assists his digestion. A change of garb may assist digestion, by assisting the mind to forget the cares of the workaday world. Even flowers on the table, and ornamental dishes, may be considered appetisers.

It will often be noticed that children who eat lazily, and languidly, and inattentively, can be made to eat with much more *relish* by insisting that they eat with more *vigour*. It will be noticed, too, that the gourmand or epicure, who takes a lively interest in the menu, rarely suffers from indigestion. In the case of the man who has to hunt for his prey, probably the very keen mental attitude of the chase is itself conducive to appetite.

In order to stimulate appetite, accordingly, it is advisable to do all things to render feeding interesting and enjoyable.

Sometimes, however, in spite of all that is done in the ways above indicated, appetite still remains a minus quantity. What is to be done, then? There are still a few measures to be tried. We may try the effect of condiments and piquant sauces. Taste and smell, as we have

seen, are closely associated with appetite ; and appetite may be sometimes aroused by a special appeal to these senses. We may also appeal to them indirectly by disagreeable impressions. Even as extremes of heat and cold produce a desire for their opposites, so by means of bitter substances we may produce a desire for articles of pleasant-tasting food. On this principle depends the digestive use of bitters. Better still, we may commence the meal with liquid meat extracts and soups, and the instinct of mankind has in many cases chosen such a commencement. The advantages of such a prelude to the more solid foods has been shown by Pawlow. He has shown that meat extract is an important chemical excitant of gastric secretion—that, in fact, there is no other substance known which is so good an excitant. " If one," says Pawlow, " arranged the ordinary fluid foods in descending order according to the influence of the chemical excitants, the following would be the series : first the preparations of flesh, such as meat-juice and the like ; secondly, milk ; thirdly, water."

Acid fruits and acid solutions are also useful, since acid is a strong excitant of the pancreatic juice, and the Russian peasant always takes a sour drink, *kwas*, with his bread.

Since the digestive process is partly determined by the food itself, and since the digestion of foods depends, in different degrees, on the appetite juice, the question as to which food is best to give in cases of lack of appetite is one of great importance. In the case of bread and of egg albumen, appetite juice (*i.e.* the juice secreted by the psychical excitement of appetite) is necessary to initiate the process of digestion. If bread or egg albumen be eaten without appetite, or introduced into the stomach unobserved, it lies there for a long time, just as stones would lie, without the least appearance of digestion. Milk and meat, on the other hand, can, by their own chemical properties, provoke secretory activity even without the assistance of appetite. In cases of lack of appetite, accordingly, milk and meat are better forms of food than bread, and when bread is given it should be first soaked in meat extract, or preceded by meat extract. Pawlow rendered the secretion of appetite juice impossible in certain dogs by dividing the so-called vagus nerves of the stomach. Under these circumstances, the digestion of the dog became most unsatisfactory. By introducing meat broth, however, before feeding, the gastric glands were caused to secrete, and digestion was rendered quite satisfactory.

It might be supposed that the introduction of artificial digestive juices, or of predigested food, would be the best remedy for lack of appetite ; but these devices seldom prove quite successful in practical experience, and it is better in most cases to stimulate the digestive glands by the means we have mentioned than to supplement their defective secretions.

THE COOKING OF FOOD

The cooking of food is a matter which is usually considered more from a standpoint of palatability than from the standpoint of digestibility. But, as we have seen, palatability is digestibility. The cook who invents piquant sauces not only tempts the palate, but also provokes the appetite and evokes the digestive juices. Fragrant, appetising dishes are better than any digestive mixture ; and food well served is probably of more nutrient value than food served *anyhow.* Eye, nose, and taste are the jackals of the stomach, and chiefly what they find and approve will the stomach devour. Well did a famous German doctor remark that his kitchen was his dispensary.

But cooking not only renders food more appetising, it also produces chemical and mechanical effects varying with the kind of food cooked, and these effects are not all favourable to digestion.

Meat and Fish.

When meat is cooked, the connective tissue between the muscular fibres is dissolved, and changed into a kind of gelatin. This enables the digestive juices to reach the individual fibres, even when the meat is gulped. But, on the other hand, the muscular fibres are themselves rendered less digestible by the coagulation of their albumens. The digestibility of the fat of the meat is practically unchanged by cooking. The changes effected in meat by cooking it are thus partly favourable and partly unfavourable to digestion. On the whole, however, there can be no doubt that meat is more readily digestible raw than cooked.

Jessen (quoted by Hutchison) found that beef, when consumed raw, takes two hours to disappear from the stomach ; when boiled, three hours ; and when roasted, four hours ; and other observers have obtained similar results. In the face of this fact, it may seem strange that cooking is so universal. Even the cannibal cooks his missionary before devouring him. Probably, however, instinct is right, and though cooked flesh may be more tardily digested yet the ultimate and aggregate result may be better.

An adventitious advantage of cooking is that it destroys germs and parasites in the meat and makes it keep better.

Meat may be cooked in various ways: it may be boiled, roasted, fried, or stewed.

When meat is *boiled* it is desirable that the flavouring constituents of the meat (the digestive importance of which we have already seen) should be so far as possible retained in the meat. This is usually achieved by plunging the meat at once into boiling water. By this means the albumens on the surface are coagulated, and the juices in the interior sealed up. As soon as surface coagulation has been produced the temperature of the water should be lowered to 165° to 170° F.; since it is found that meat (and this principle applies equally to eggs) forms a softer coagulum when boiled at a temperature considerably below the boiling point of water.

When meat is *roasted*, the same rule should be observed: the surface of the meat should be sealed by exposure to a high temperature, and thereafter the meat should be cooked at a lower temperature. The result of roasting is not only to retain the natural flavours of the meat, but to develop on the surface an additional flavouring brown matter known as *osmazone*.

When meat is *fried*, the great heat of the boiling oil produces instantaneous coagulation of superficial protein and rapid cooking of the deeper portions of the meat.

When meat is *stewed*, the water is never allowed to boil, and should never, indeed, be allowed to exceed a temperature of 180° F. No attempt is made to retain the flavouring matters in the meat, since all those which escape are taken in the gravy. According to Dr. Hutchison, "stewing is in many respects the ideal method of cooking food."

Fish is cooked on the same principles as meat.

Vegetables.

Vegetables contain proteins, starches, sugars, fats, and cellulose. Vegetable proteins, like animal proteins, are coagulated by cooking, and rendered less readily digestible. Vegetable fats are practically unaltered by cooking as regards their digestibility. Vegetable sugars undergo various changes, and may be converted into "invert" sugar, or into barley sugar, or into the dark bitter substance known as *caramel*. But none of these changes is of great dietetic importance, and the importance of cooking with

regard to vegetables depends on its action on the characteristic vegetable constituents of starch and cellulose.

The starch of vegetables occurs in conjunction with an indigestible woody substance known as cellulose, which, indeed, surrounds the grains of starch and protects them from the digestive juices. On subjecting the starch grains to moist heat, however, they swell and burst their envelope of cellulose, and run together to form a starch paste or jelly. Thus cooking renders the starch available as a nutrient substance. The more cellulose present, the more necessary does cooking become. Uncooked starch is of no service as a food, unless the cellulose envelope has been broken up by grinding or milling.

Since starch is the most important nutritive constituent of most vegetables, the effect of cooking vegetables is to render them, on the whole, more digestible.

During cooking, meat loses water and becomes more concentrated; while vegetables gain water and increase in bulk, and both meat and vegetables lose salts and extractive matters. It is a strange anomaly that meat cooked in water should *lose* water, yet so it is.

The importance of good cooking cannot be too much emphasised, and it is desirable that cooks should understand not merely the rule-of-thumb part of their business, but also the principles of nutrition on which all cooking should be based. The waste of nutrient material due to bad cooking, and the consequent twofold loss of money and energy, must be enormous.

PRESERVATION OF FOODS

From earliest times the art of preserving foods has been practised. At the present day various methods of preservation are in vogue. Foods are preserved by means of the condiments, salt, sugar, and vinegar ; by smoking with wood smoke, by treating with chemical agents, and by sterilising.

The method by pickling with *salt* is of ancient origin, but is still in very common use, and is employed to preserve both meat and fish. The salt is kept in close contact with the meat or fish for some time, so that it may penetrate to the interior of the flesh. It exercises at once a hardening, a drying, and a germicidal action, but it does not prevent the "ripening" of the meat.

Sugar is generally used in conjunction with salt to preserve ham, and

gives the ham certain flavours that are much esteemed ; it is also used incidentally in the making of fruit preserves.

Vinegar is used chiefly to preserve vegetables.

Smoking with wood smoke is often supplemental to curing with salt. The chief desideratum is to obtain a pleasant aromatic smoke which will give an agreeable flavour to the tissues cured, and with this object in view oak, maple, and hickory wood are specially used.

The *chemical agents* used to preserve meat are borax, boracic acid, and sodium sulphite. Sodium sulphite is not so commonly used, and is employed chiefly to preserve the flesh colour of the meat. These chemical preservatives all act quickly and efficiently, but they are detrimental to health, and should be avoided.

The process of *sterilisation* was invented by a French confectioner in the beginning of the nineteenth century, but has since been much developed. The substance to be preserved is first boiled, and then, after being sealed in cans, is subjected to high degrees of heat—225° to 250° F. In some cases, the cans are exhausted *in vacuo* before being sealed. As a method of preservation sterilisation is most efficacious, but the drawback is that there is not much control over the character of the substances sterilised.

Food can also be preserved for some time by *cold storage*. How long meat can be kept with advantage in cold storage is a debatable question. "It is probable that the fresh beef which is served to the people of the United States is on an average a month old, and is said to be improved by keeping this length of time" (Wiley). It is also probable that if meat be kept for more than a month it will deteriorate.

CHAPTER LXXXV

VEGETARIANISM—THE HAIG SYSTEM—ECONOMY IN DIET

Man Originally Frugivorous—The Real Question Involved in Vegetarianism—Difficulty of Settling It—Haig's System—Uric-acid-free Foods—Wasteful Feeding—Cost of Food and Nutritive Value

VEGETARIANISM

No discussion of food can be complete without a discussion of that dietetic creed known as "vegetarianism," which preaches salvation for the body by a dietary consisting more or less exclusively of vegetables. The value of vegetarianism has been keenly debated, and arguments *pro* and *con* have been drawn from innumerable quarters. Cuvier, in his work "The Animal Kingdom," affirms: "The natural food of man, judging from his structure, appears to consist of fruits, roots, and the succulent parts of vegetables."

Sir Charles Bell infers from the formation of man's teeth and digestive organs, and from his skin and limbs, that man was originally a frugivorous animal, and other authorities are of the same opinion. The apes and monkeys, which are next of kin to man, and which closely resemble man in their teeth, eat chiefly fruits and grains, especially nuts. By structure and heredity, therefore, it must be admitted that man is a vegetarian. It is also pointed out by vegetarians that animal diet involves great suffering on the part of the lower animals, and that animal food tends to coarsen the temperament and tastes of those who indulge in it. It is urged, too, that vegetable diet is much more economical than animal diet.

Man Originally Frugivorous.

It would be foolish, however, to determine diet merely by æsthetic or economic considerations, or by considerations of structure or heredity. The purpose of food is to maintain tissue integrity and supply energy, and the question comes to be the practical one, Can health and strength be equally well sustained by a vegetable diet as by a mixed diet? To decide this question we may compare races that are mixed feeders with races that are vegetarians. The

The Real Question.

comparison is rather in favour of the vegetarian. The monkey, gorilla and orang-outang, which are all plant-eaters, are at least as strong as any of the carnivora, and the Scotsman nourished on oatmeal, or the Chinaman nourished on rice, has as great muscular power as the Englishman nourished on beef. All over the globe, too, we find vegetarian races of fine physique and of great energy. Still, a comparison of this sort is not conclusive. A Chinaman may be strong on rice ; he might be stronger yet on beef. A Scotchman may be strong on porridge ; he might be stronger yet on pork. We can decide the question only by experimenting with both diets on a sufficient number of individuals. The experiment has often been made, but not on a large enough scale, and the results accordingly are not conclusive. In some cases a change from vegetable to mixed diet has resulted in increased health and vigour, and in some cases the reverse change has been equally salutary. Some flourish best—or think they do—on mixed diet ; some flourish best—or think they do—on a diet of plants. Even among vegetarians there are considerable differences of opinion. Some allow milk and eggs ; others resolutely ban them. Some put their faith in cereals ; others put their faith in nuts. Some are large eaters, some small.

In a general way, it may be said that vegetarians, *ceteris paribus*, have more *endurance* than mixed feeders, but that mixed feeders have more *initiative* and *activity*, both physical and mental. The Irishman in Ireland fed on potatoes is not famous for his energy, but send him to America and feed him on plenty of meat and he becomes a very tornado of energy. But even here, of course, the change in temperament cannot be ascribed wholly to change of diet.

Professor Chittenden, in the course of his most valuable experiments, has demonstrated that energy is best procured by the consumption of carbohydrates, and carbohydrates are obtained almost exclusively from plants. The question, therefore, comes to be, Can the proteins necessary for building and repairing the tissues of the body be best obtained from animal or from vegetable sources ? Here the difference of opinion becomes acute. On the one hand, proteins are found in flesh in assimilable and concentrated form. On the other hand, we are apt to consume, with the proteins of flesh, waste products which are pernicious and dangerous. Again, proteins are found in many plants unmixed with these injurious waste products. But, again, these plants, such as the pulses (peas, beans, lentils), which contain most protein,

also contain deleterious substances, and those which contain little protein require to be consumed in excessive quantities in order to obtain sufficient protein.

One of the chief disadvantages of vegetarian diet, indeed, is the large amount of vegetables it is necessary to consume in order to obtain sufficient protein. The result is over-distension and overwork of the stomach and bowels, with a tendency to diarrhœa.

This disadvantage of bulk can be obviated by adding eggs, milk, and cheese to the diet; but then the diet becomes no longer vegetarian. It can also be obviated by adding pure vegetable protein to the diet.

The question of vegetarianism is a very difficult one. The truth is that the human constitution is so very adaptable, that it can thrive under a great variety of conditions and on a great variety of diets, and considerable differences in diet do not therefore produce differences in health and energy.

But it must be allowed that the vegetarians, whether we accept their theory or not, have done good service in helping to explode the superstition that a man can be muscularly energetic only on a diet of meat.

HAIG'S SYSTEM

Dr. Haig is neither a vegetarian nor an indiscriminate mixed feeder; he is an eclectic, and selects his diet on special principles of his own. He starts with the old doctrine—which is now a heresy—that force is derived almost exclusively from proteins, and that the action of sugar and starch as force producers is so slight as to be negligible. "We may sum up," he writes,* "the main points in the physiology of the subject by saying that the first requisite for strength and power of endurance is a satisfactory and sufficient supply of albumens, that the body depends for these chiefly on the food taken from day to day, but that there is also a small store of these substances in certain tissues which becomes available for use, if prolonged exercise is called for in the absence of food, and further, that beyond this point in continued starvation certain definite quantities of the tissues themselves are daily absorbed to produce the necessary albumens and urea." By estimating

* "Diet and Food in Relation to Strength, Power and Endurance, Training and Athletics." (J. and A. Churchill.)

the amount of protein waste excreted from the body he is able, accordingly, on this theory to estimate the amount of protein food required for purposes of energy, and he lays down the general law that we can get the number of grains of protein required, by multiplying a man's *normal* weight in pounds by 9 or 9·5, according to the amount of exercise he takes. Thus, according to this law, a man weighing 160 pounds will require $160 \times 9 = 1{,}170$ grains of protein if he be living a sedentary life, or $160 \times 9{\cdot}5 = 1{,}365$ grains of protein if his life be more active. This, then, is the amount of protein required. But it is not enough merely to provide protein; we must provide the most suitable protein—"protein in a condition suitable for digestion and absorption, and we must see that there is a satisfactory circulation to carry it to the tissues."

As a corollary of Haig's theory of force it follows that fatigue is due to a lack of protein in the blood, or to a defective circulation of it through the tissues, together with a retention of waste products. Protein is rarely lacking, and, if lacking, is easily supplied, so that the main cause of fatigue is its defective carriage by the circulation, and this again, according to Haig, is due to excess of uric acid in the blood. Now uric acid can be cleared by doses of salicylic acid, or opium, or mercury. But it is better still, Haig maintains, to live on a diet which produces no uric acid, and he gives the following group of uric-acid free foods:

Uric-acid-free Foods.

Milk and milk products, as cheese and "Protene"; bread stuffs, cereal foods, and glutens; nuts and nut foods; garden vegetables, as potatoes; garden fruits, as apples; dried and foreign fruits. It will be noticed that Haig excludes animal flesh and eggs, and that, with the exception of milk and milk products, his dietary is vegetarian. He is not, however, an orthodox vegetarian, since he also excludes tea, coffee, cocoa, and the pulses (peas, beans, lentils, etc.). His two criteria of correct diet are sufficiency of protein and absence of uric acid. Dr. Haig especially recommends milk, Protene (which is the protein of milk in almost pure form), cheese, gluten (which is the protein of flour), and nuts; but he thinks it best to live on a compound dietary containing articles out of all the six groups above mentioned. In carrying out his diet care should be taken that the food is not too bulky, too starchy, or too fluid, and that meals are not given too frequently. He gives as specimen diets for a man of 140 pounds the following:—

TABLE I

10 oz. of bread,	8 per cent. of albumens (or proteins)	=	340 grs
2 oz. of oatmeal,	12 ,, ,, ,,	=	104 ,,
2 pints of milk,	3 ,, ,, ,,	=	525 ,,
2 oz. of cheese,	33 ,, ,, ,,	=	281 ,,
1 oz. of nuts,	16 ,, ,, ,,	=	68 ,,
18 oz. of fruit and vegetables, say ½ to 2 per cent. of albumens (or proteins		=	152 ,,
			1,470

TABLE II

5 oz. of Hovis bread,	16 per cent. of albumens (or proteins)	=	340 grs.
2 oz. of oatmeal,	12 ,, ,, ,,	=	104 ,,
1 oz. of gluten,	80 ,, ,, ,,	=	344 ,,
1 pint of milk	3 ,, ,, ,,	=	262 ,,
3 oz. of cheese	33 ,, ,, ,,	=	421 ,,
			1,771

TABLE III

3 oz. of cheese,	33 per cent. of albumens (or proteins)	=	421 grs.
3 pints of milk,	3 ,, ,, ,,	=	787 ,,
14 oz. of potatoes,	2 ,, ,, ,,	=	120 ,,
16 oz. of fruit,	2 ,, ,, ,,	=	137 ,,
			1,465

Though Dr. Haig's theory of the origin of energy is almost certainly incorrect, yet his diet is certainly useful in certain forms of disease, characterised by excessive formation of uric acid, or by excessive sensitiveness to its presence. It is also useful in cases of obesity, especially if rice or Protene or gluten is substituted for bread.

ECONOMY IN DIET

The question of the price of food influences, and must always influence, the question of diet. The rich Roman fed on the tongues of nightingales, and Cleopatra drank pearl-dust in her wine; and the rich man to-day pampers his palate with as foolish delicacies: he takes quail instead of hen, and oysters instead of eggs, and *pâté de fois gras* instead of liver, and flatters himself, perchance, that his diet is rich and strengthening. Even the general diet of a nation changes with its prosperity. The Scots no longer live on oatmeal, and the Japanese are beginning to substitute flesh for rice. In

Wasteful Feeding.

New Zealand and Australia and America, where wages are high and food cheap, there is a tendency to indulge in too much meat and to eat too much food generally.

There are no more erroneous notions than that the more the food consumed, the stronger the feeder, and that the most expensive articles of food are the most nutritious. As a matter of fact, and as has been shown in the preceding pages, food, beyond a certain amount, diminishes instead of increasing strength, while the most nourishing articles of food are often the cheapest—pea-soup, for instance, is much more nourishing than turtle soup, and eggs are much more nourishing than oysters.

And if the rich man wastes his money on food, the poor man cannot be said to spend his food-money wisely. A large proportion of the population are underfed; but they are underfed not because of their poverty, but because of their deficient political economy—from their ignorance and wrong choice of foods. "The wasteful expenditure, even of the poorest, is deplorable," writes the Hon. Rollo Russell. Dr. Hawkes, of Finsbury, found that women there drank 3 or 4 pints of tea a day, and that children were fed on pickles and vinegar.

By economical purchase of food, the health of the whole nation might be benefited and its wealth increased. If half the money wasted by the poor in their purchase of food were saved, there would be no more difficulty about old-age pensions; and if any philanthropist desires to redeem the world from much vice and disease and misery, he will do well to tackle not merely the drink question, but the food question—by providing machinery to teach the poor, and also the rich, how much nutritive material they require, and how it can be best and most economically purchased. There are chairs of Arabic and chairs of Anglo-Saxon, chairs of Agriculture and chairs of Music, chairs of Psychology and chairs of Toxicology, but in the whole of Great Britain there is not a single chair of Food, which is, after all, the subject of chief importance for the welfare of the nation. "Could a generous dietary be provided for all the children of the poor," declares Sir James Crichton-Browne, "one-half of the disease, pauperism, and crime that now burden the country would have disappeared by the next generation."

"Alimentation," says Mr. R. Russell, "is clearly a subject of national concern. Armies and navies are now pretty well provided with a scientific dietary, and the heavy mortality which formerly

accompanied the provision of improper food is not likely to occur again, except by accident. It is equally desirable, in the long run, that the population which supplies army, navy, and all the industrial strength of the empire with raw material, should be raised to a high level of efficiency."

If we wish to outstrip our rivals in the race for empire, if we wish to build up a sturdy imperial people, we must study food as a great science, and not relegate the subject to the kitchen and the abattoir. Our population *must* be educated in the principles of diet, and especially in principles of economic catering, otherwise physical degeneracy must ensue.

Let us glance for a moment at some of the relationships between the cost of food and its nutritive value. As we have already said, the two things run by no means *pari passu*. Wheat, and oatmeal, and rice, and peas, are very cheap foods, yet they are very inexpensive. Mr. Russell, in his "Strength and Diet," gives the following tables, which are still significant and instructive, although prices have undergone variation since they were compiled :—

Cost of Food and Nutritive Value.

	Protein	*Fat*	*Carbo-hydrates*	*Fuel Value*
One Shilling will buy of :				
Round of beef at 8½d. per lb.	·26	·17	—	1,235
Round of beef at 5d. per lb.	·44	—	—	2,105
Salt fat pork at 7d. per lb.	·03	1·40	—	6,025
Mutton at 9d. per lb.	·20	·20	—	1,245
Mutton at 5d. per lb.	·37	·35	—	2,245
Fresh cod at 3d. per lb.	·45	·01	—	945
Pork (smoked ham) at 8d. per lb.	·20	—	—	2,435
Whole milk at 4d. per quart	·19	·23	—	1,915
Skim milk at 2d. per quart	·04	·03	·61	2,085
Butter at 1s. 6d. per lb.	·01	·54	—	2,320
Butter at 1s. 3d. per lb.	·01	—	—	2,770
Eggs at 1s. 6d. per dozen	·10	·07	—	475
Cheese at 7d. per lb.	·43	·55	·04	3,265
Wheat bread at 1⅛d. per lb.	·76	·13	5·57	12,421
Oatmeal at 1½d. per lb.	1·08	5·3	5·39	14,430
Rice at 1¾d. per lb.	·45	·02	5·27	10,795
Potatoes at ½d. per lb.	·14	·02	3·60	7,470
Beans at 2d. per lb.	1·05	·10	3·47	8,960
Sugar	—	—	6·86	14,760

According to this table, the food giving most nutriment, and supplying most energy in proportion to its cost, is oatmeal, which has been pre-eminently the food of Scotland, where the value of money is supposed to be best known. According to other authorities, however, wheat bread is the most economical food. Goodfellow affirms that a pennyworth of bread yields 8 ounces of dry nutriment, a pennyworth of oatmeal 7½ ounces, a pennyworth of potatoes 5½ ounces, a pennyworth of rice 5¼ ounces, a pennyworth of meat 4 to 5 ounces. Bull declares that 1 pound of protein in the form of flour costs 5½d., in the form of oatmeal 7½d., in the form of rice 1s. 5d., in the form of beef 1s. 4½d. to 4s. 5d., in the form of eggs 5s. 0½d.

It will be noticed that skimmed milk is a cheaper food than whole milk, in proportion to the nutriment obtained for a given price. Sugar will be seen to have great fuel-value, but since it contains no protein it is not sufficient in itself to sustain life. Eggs are obviously uneconomical. Carbohydrates are seen to be cheaper than proteins and fats.

As a whole, the vegetable foods are more economical than the animal foods, and this is the case even if we make allowance for the less complete absorption of vegetable proteins. It is clearly quite simple to live on a shilling a day on articles selected from these tables. Maize, which is not included in the above tables, is one of the most economical foods ; it usually sells at about the same price as wheat, and contains less protein, but a correspondingly greater amount of carbohydrates.

It is very strange that food should not be sold at prices corresponding to its real nutritive value, but, like other commodities, its price varies with demand and supply, and there are some extraordinary discrepancies between the market and the nutritive value of certain foods. A pound of cheese at 8d. contains as much nutritive material as 2 or 3 pounds of beef at 1s. Bermuda arrowroot may cost six or eight times as much as the cheaper arrowroots, yet it is no more nutritious ; and, indeed, arrowroot in any form is an extravagant luxury, since a cupful of it contains only about 30 grains of starch supplying about 9 Calories of fuel. Sole, again, costs perhaps 1s. 6d. a pound, while haddock, which contains quite as much nourishment, may be bought at less than a quarter of that price. Stilton cheese costs 1s. 2d. a pound, while other cheese equally nourishing can be purchased at 6½d. per pound. Butter, which is much dearer than margarine, has no more nutritive value.

A certain lentil preparation costs upwards of 3s. per pound, while lentils of the same nutritive value can be bought for a few pence.

Flavours may sometimes be worth paying for. We have seen that flavours are digestive adjuncts ; but the poor man spending fully 50 per cent. of his wages on food must be content to do without the dearer flavours, and must see that he gets his money's worth in actual fuel-value, and the pathetic thing is that he usually has not the least idea how to get it.

In estimating the food value of various articles, allowance must be made for unavoidable waste, which is a very variable quantity.

It is wonderful how economically it is possible to live if the right articles of food be selected. Dr. Atkinson lived a sedentary life for long periods on about 12 ounces per day of oatmeal (dry) or the equivalent in cracked wheat or other grain, supplying about 1,400 Calories a day, and it is quite possible to keep up health and strength on a diet costing less than 6d. a day.

The economy of food can also be considered from a still larger and broader standpoint, with reference to the nutritive value of an acre of each. Viewed from this standpoint, chestnuts and bananas are most economical, since more nutritive value can be obtained from an acre of these than from an acre of any other kind of food. Viewed from this standpoint, too, potatoes are particularly economical.

CHAPTER LXXXVI

COMMON ARTICLES OF FOOD

Milk and Milk Products—Eggs—Cereals : Wheat, Oats, and Rice—Potatoes—Turnips, Carrots, Parsnips—Green Vegetables—Pulses : Peas, Beans, Lentils, Peanuts—Fruits—Nuts—Sugar—Meat—Poultry and Game—Fish.

Having now considered food in general, we will proceed to discuss in more detail the various articles of food most used in the diet of mankind.

Milk.

Milk is the food *par excellence* of all young mammalian animals. It is a dilute food, but contains all the constituents (proteins, carbohydrates, fats) necessary both for the formation of tissue and for the production of energy. The exact composition of milk varies considerably with the cow, with the condition of the cow, with the diet of the cow, and other circumstances. The average composition is given by Dr. Hutchison, in his "Food and the Principles of Dietetics," as follows :—

COMPOSITION OF COW'S MILK

Water	87 to 88	per cent.
Proteins	3 to 3½	,,
Sugar	4 to 5	,,
Fat	3½ to 4½	,,
Mineral matters	0·7	,,

It will be noticed that the proportion of protein to carbohydrate (sugar) is unduly large, but it must be remembered that milk is food for babes, not for adults, and that in babes the necessity for nitrogen to build up the growing tissues is urgent, while the expenditure of energy is very small. Bedridden invalids, like babes, use little energy, and so for them, as for babes, milk is a suitable food.

It will be noticed, too, that a large percentage of milk is water. This also has to do with the fact that it is essentially food for infants who have often no other source of water. It renders milk more easily digest-

ible by invalids, but it renders it unsuitable diet for those engaged in manual labour, and though the proteins of milk are very digestible, it is not often used for training. In fact, it would be necessary to consume 7 or 8 pints of milk a day in order to provide the energy an adult usually expends, and this would mean the introduction of larger quantities of fluid than are compatible with athletic activity. In spite of these drawbacks, and of the further drawback that it is very incompletely absorbed, it occupies a very important place in the dietary of all nations, for though not suitable as a sole article of diet, it is most valuable in a supplemental capacity.

The *proteins* of milk are known as *casein* and *lactalbumen*, and in cow's milk the latter occurs only in very small quantities.

The *carbohydrates* of milk occurs in the form of a sugar known as *milk sugar* or *lactose*. When split up by certain micro-organisms, lactic acid is formed, and the milk becomes sour.

The *fat* of milk exists in the form of a very fine emulsion. When the milk stands it rises to the top as cream, or it may be separated by a centrifugal separator.

The *mineral* matters of milk are chiefly phosphate of lime, which goes to the making of bones, and phosphate of potash, which goes to the making of muscles.

The richness of milk is usually estimated by its richness in fat, since it is found that, as a rule, the other constituents vary proportionately. Ordinary milk contains $3\frac{1}{2}$ to $4\frac{1}{2}$ per cent. of fat. Milk of a Jersey cow may contain as much as 7 per cent. of fat. It is illegal to sell milk with fat contents below 2·8 or 3 per cent., and milk in which there is only 3 per cent. of fat is either bad or watered.

When milk is swallowed it forms, in the ordinary course of digestion, a clot of casein of more or less firm and tough consistence. This clotting is due to a chemical agent or *ferment* in the stomach known as *rennin*, and can be equally well produced outside the body by adding rennin to warm milk, when the clot is usually known as *junket*. The clot contracts and squeezes out whey, and, under some conditions, may be so tough and dense as to be somewhat indigestible. Too dense clot may be prevented in many ways. It may be prevented by diluting the milk with an equal bulk of water, or lime water, or aërated water, or barley water, or by adding citrate of soda to the milk. It can also be prevented in a great measure by sipping the milk slowly, and by tasting

and insalivating it before swallowing it. It is sometimes said that milk should not be drunk with meals but between meals; but that is a mistake. Milk is best taken with meals; it is really a solid food, and the clot is likely to be less consistent if it is mingled with other articles of food.

It is well to understand thoroughly that milk is, as a rule, a very digestible food. Pawlow has shown that even when it is introduced directly into the stomach it is able, by its own chemical characters, to excite secretion of gastric juice more powerfully than any other article of diet except extract of meat, and he has also shown that it requires for its digestion a less expenditure of gastric ferment than any other food. These two characteristics render it eminently digestible, and the idea prevalent among certain sections of the public that milk is difficult to digest is quite unfounded.

Unfortunately, milk is a happy hunting ground for germs. In milk most germs flourish and multiply exceedingly. "Unfortunately, too, byre and dairy conditions," as Mr. Russell says, "are not always as clean as they should be. Farms from which milk is sent to towns are often exceedingly filthy, and when it reaches the consumer it is badly contaminated. The cows are filthy when milked, the milkers are dirty, their vessels are dirty." London milk was found to contain in 14 per cent. of samples the tubercle bacillus, and many epidemics of typhoid and scarlet fever have been spread by milk.

It is necessary, accordingly, that milk should be heated or boiled or sterilised, to destroy the germs it may contain. Boiling milk for a few minutes is usually all that is necessary, but if it be requisite to keep the milk for some time it must be heated to 230° F.

The effect of the heating on the digestibility and nutritive value of the milk has been much debated. It is probable that boiled milk is rather less digestible than raw milk, but the difference is so slight as to be negligible.

Goat's milk is sometimes used instead of cow's milk; it has more casein and more fat, but less sugar. Ass's milk, on the other hand, has less casein and less fat, but more sugar. Human milk has less casein and more sugar.

Cream is the fat of milk removed either by skimming or by treatment with a separator. Cream contains casein, milk, sugar, and mineral matters, but it should contain at least 18 per cent. of pure

fat ; and cream of first-class quality should contain at least twice or thrice that amount.

Milk Products.

Devonshire cream is clotted cream obtained by heating milk in deep pans.

Cream is a valuable fuel-food, and is almost as nutritious as cod-liver oil.

Skimmed milk is the residue which is left when the cream has been removed from the milk. It lacks fat, but still contains casein, and in proportion to its price, as we have said, has more nutritive value than whole milk.

Koumiss is, properly speaking, a fermented preparation of mare's milk. It is often, however, made of cow's milk, and is then sometimes known as *kephir.* Cow's milk does not contain so much sugar as mare's milk, so sugar or honey is usually added to facilitate fermentation.

Koumiss is of great value in certain cases of dyspepsia with sickness, when milk and other foods cannot be borne. It is also a useful article of diet in phthisis, and may be consumed in huge quantities—3 or 4 gallons a day.

The *casein* of milk is procurable in a dry and isolated form, and several preparations of milk casein are on the market, among them Protene, Plasmon, and Sanatogen. Protene and Plasmon contain about 80 per cent. of pure casein ; Sanatogen contains, in addition to casein, 5 per cent. of glycero-phosphate of sodium.

These casein preparations are of undoubted dietetic value, and are especially useful when it is desirable to give vegetable proteins without the large and disproportionate amount of carbohydrate naturally associated with these.

Butter is the well known fatty material obtained by churning cream which is just beginning to turn sour. It contains on the average about 82 per cent. of fat, and a little casein and milk sugar. Butter fat contains 7 per cent. of butyric acid and 40 per cent. of olein. Olein has a low melting point, is very easily absorbed, and butter is probably the most readily and most completely absorbed of all fats Its caloric value is naturally high—1 pound of butter will yield over 2,000 Calories. It is easily digested, even by dyspeptics and consumptives, and Dr. Hutchison suggests that it should be used as a substitute for cod-liver oil.

Buttermilk is the sour fluid residue of the milk left after butter has been removed from the churn. It contains about 3 per cent. of protein and about ¼ per cent. of lactic acid. Its percentage of protein would be seen to be the same as that of pure milk, and the fluid is, accordingly, of considerable nutritive value.

Sour milk is milk soured and curdled by the lactic acid bacillus. It has antiseptic properties, and is sometimes serviceable in arresting intestinal putrefactions. Metchnikoff considers that indulgence in sour milk may retard the approach of old age, and certain races who habitually use it are famous for their longevity.

Margarine or *oleo-margarine* is a substitute for butter, prepared from animal fats. Like butter, it consists chiefly of olein, and, like butter, it contains about 82 per cent. of fat. Its nutritive value is about equal to that of butter, it keeps better, and is very much cheaper.

Cheese is a solid substance obtained by pressure from clotted milk, and consists of water, fat, and nitrogenous matter in about equal proportions. The character of the cheese, however, varies with the milk used, with the special mode of preparation, and with the bacteria used to ripen it. Cream cheeses are made from diluted cream, and contain a large proportion of fat. The harder the cheese the better it keeps, and the more nourishment, bulk for bulk, it contains. The nutritive value of cheese is very high. A pound of Cheddar cheese contains all the casein and most of the fat in 1 gallon of milk—about twice as much nutriment as is contained in 1 pound of beef. Unfortunately, however, cheese, owing to the fat it contains and its concentrated character, is difficult to digest, even though it contains in itself digestive ferments which may aid the digestion of other foods. This peculiar combination of indigestibility and digestive ferments is indicated in the saying, "Cheese, thou mighty elf, digesting all things but thyself." Cheese may be rendered more digestible by chewing it well, or by grating it ; or it may be dissolved, as Mattieu Williams has suggested, by means of bicarbonate of potash.

Eggs.

An *egg* is theoretically an almost perfect food, for from its contents, with the aid of a little oxygen, is formed the young bird. The eggs most commonly used for food are those of the hen, duck, goose, and turkey. The chemical composition of these is given by Wiley in "Foods and their Adulteration" (J. and A. Churchill), as follows :—

COMPOSITION OF EDIBLE PARTS OF EGGS

	Water per cent.	*Protein per cent.*	*Fat per cent.*	*Ash per cent.*	*Calories per cent.*
Hen	73·7	13·4	10·5	1·0	985
Duck	70·5	13·3	14·5	1·0	985
Goose	69·5	13·8	14·4	1·0	850
Turkey	73·3	13·4	11·2	1·9	

It will be seen that all of these eggs resemble each other in composition, but that duck and goose eggs are richer in fat than hen or turkey eggs.

An egg, however, is uniform neither in appearance nor in chemical constitution. As is well known, there is a central yellow portion known as the yolk, and a circumferential white portion known as the white, of the egg. Of these the yolk is the richer and more complex in constitution, as will be seen from the following table :—

THE WHITE AND THE YOLK OF EGG

	Water	*Protein*	*Fat*	*Other Non-nitrogenous Matter*	*Mineral Matter*
White	85·7	12·6	0·25	—	·59
Yolk	50·9	16·2	31·75	0·13	1·09

The proteins of eggs are vitellin and nuclein, and nuclein is of especial interest, since it contains both phosphorus and iron.

The fats of eggs resemble the fats of butter, and are equally readily absorbed. It will be noticed that there is no carbohydrate in the egg The chick in the egg requires fuel for heat, not for energy, and fuel is found in its most compact form in fat.

The minerals in the eggs are chiefly lime salts (which go to the making of the bones of the bird), iron, and phosphorus.

Eggs also contain some complex substances known as phosphatides. They are supposed to be connected with nerve nutrition, and the most important and plentiful of these is "lecithin."

The nutritive character of eggs can be seen in their composition. Abundance of proteins, with lime and iron, render them suitable

for building up the tissues of growing animals, and they are especially useful in rickets. Lack of carbohydrates, on the other hand, renders them unsuitable diet for active adult life unless in combination with carbohydrates ; and instinct, in accordance with this scientific prescription, prescribes that they be given on toast or in starchy puddings. Raw eggs are more quickly digested than boiled or fried eggs, and hard-boiled eggs, unless chopped small, are rather indigestible. Whipping an egg renders it more easily digestible.

Custard powders and *egg powders* are composed chiefly of starch, coloured with some vegetable dye.

Cereals.

The various cereals—wheat, oats, maize, rye, etc.—are all characterised by similar chemical constitutions, and contain protein, fat, carbohydrate, cellulose, and mineral matter, with a large preponderance of carbohydrate (in the form of starch)—61 to 80 per cent. This preponderance of carbohydrate renders them useful as energy providers ; but they have not quite sufficient protein for tissue building, and as articles of diet require to be supplemented by articles containing more protein. Thus we take milk with porridge, and cook rice in milk, and eat bread with cheese, and take corn-cobs with butter.

We will discuss briefly, as representatives of the group, wheat, oats, and rice.

Wheat.

Wheat is the most important source of carbohydrate material in the diet of Western nations. In the United States alone there are about 30,000,000 acres of wheat land. The percentage composition of wheat flour varies considerably with the wheat, and according to the parts of the grain included in the flour. The grain really consists of three parts—*germ*, *endosperm*, and *bran*. The germ contains most protein, the endosperm most starch, and the bran most cellulose matter. In ordinary milling, the bran and germ are both removed —the bran because it is too tough to grind, the germ because it contains oil, which is apt to turn rancid, and a ferment which acts upon the starch. The result is that the wheat flour contains proportionately less fat, less protein, and more carbohydrate than the whole grain.

Wheat-flours are prepared of varying degrees of fineness and containing varying quantities of starch and gluten. They are known by various names—" patents," " households," etc.—according to their ultimate composition. Ordinary white bread is made of different kinds of " households."

Hovis flour is flour containing the germ, and therefore richer in proteins than ordinary flour. The ferment of the germ is killed by superheated steam, and the fat is sterilised by this same means. Hovis bread contains one part in four of this flour.

Frame Food Extract is an extract made from bran, by boiling the bran under high pressure, so as to break down most of its cellulose and to extract its minerals and nitrogen.

Bread is *baked* in order to render it more digestible. On the one hand, the starch grains are broken up by the moisture and heat ; or, on the other hand, the gluten is rendered more digestible by being blown up—made to *rise* by gas blown through it. As is well known, when yeast acts on sugar carbonic acid gas and alcohol are formed ; and the gas commonly used to make the bread spongy is carbonic acid gas, formed by the action of yeast on sugar in the flour. The carbon dioxide becomes entangled in the gluten and makes it light and spongy, while the alcohol is evaporated by the heat.

In other cases, carbonic acid gas is prepared from chemical substances, and water saturated with the gas is mixed with the flour under pressure. When the pressure is reduced, the dough is blown up by the expanding gas. Bread made in this way is known as *aërated* bread.

In yet other cases the gas is obtained from baking powders composed of chemical substances, which give off carbonic acid gas when mixed with the moist dough. Most baking powders are made of a mixture either of tartaric acid or bitartrate of potash with bicarbonate of soda.

Brown bread is commonly considered more nutritious than white bread. The term is rather vague and elastic, but if it be used to denote ordinary wholemeal bread, as contrasted with bread made of refined flours, then brown bread is *not* more nutritious than white bread. In fact, white bread is usually much richer in protein than brown bread, unless the brown bread contains the germ of the flour. On the other hand, the additional amount of cellulose in the brown bread means an additional amount of residue in the intestines, and this is of distinct advantage in certain cases of constipation. Further, the larger amount of mineral matter in brown bread renders it suitable for growing children and in cases of rickets.

Atwater gives the following analysis of white bread and brown bread, with reference to the protein each contains :—

WHITE AND BROWN BREAD

	Water	Protein	Mineral Matter
White Bread . .	35·4	9·5	1·1
Brown Bread . .	40·0	9·5	1·9

Bread taken as a sole article of diet is not well absorbed, and since it has no power in itself of exciting a secretion of gastric juices, it should be thoroughly well insalivated before it is swallowed. *New* bread, which cannot be well insalivated, is most indigestible, and should never be eaten. When bread is taken along with other kinds of food, such as milk, it is absorbed much more readily and completely. Bread soaked in gravy is a very good combination, too little used. When bread is toasted it is rendered more palatable ; it is also more likely to be thoroughly masticated. On the other hand, if it be soaked in butter, it is rendered more indigestible ; and a meal of tea and buttered toast is not to be recommended.

Bread contains only 35 or 40 per cent. of water, and thus, in proportion to its weight, is a most nutritious food. In common with all cereal foods, however, it contains a deficiency of proteins ; it has the disadvantages, already mentioned, that it cannot of itself excite secretion of gastric juice, and that it requires a large amount of gastric juice for its digestion.

Biscuits contain the food constituents of bread in more concentrated form, and owing to their dryness, even when "plain," they exercise a more stimulating effect on the salivary glands.

Semolina, macaroni, vermicelli, are all wheat foods rich in protein and carbohydrate, and therefore of considerable nutritive value.

Oats.

Oats have been defined as the food of men in Scotland and of horses in England, and the definition has called forth the question, "And where can you find such men and such horses ?" Certainly oats are one of the most nourishing of the cereals, and for many generations the Scotch maintained their vigour of mind and body on a diet consisting chiefly of oatmeal.

Before oats are used for human food the husk is removed ; but since the husk is very adherent to the kernel it is difficult wholly to remove it, and a certain amount always remains in the oatmeal. Scotch oatmeal

contains 5 per cent. of water, 14 per cent. of protein, 9 or 10 per cent. of fat, 65 per cent. of carbohydrates, 3·1 per cent. of cellulose, and 2·1 per cent. of mineral matter. It will be seen that the percentages of cellulose and fat are comparatively high. The high percentage of cellulose, and the rather gritty form in which it occurs, make oatmeal a useful stimulant of the bowels, while the high percentage of fat greatly increases the fuel-value of oatmeal food.

Quaker Oats and *Waverley Oats* are flattened and crushed between heated rollers so that the cellulose is broken up and the grains are partially cooked.

Oatmeal is not only highly nutritious, but has also a high degree of absorbability.

Dr. Hutchison, in his "Food and Dietetics," draws a very striking comparison between a meal of bread and butter and tea, and a meal of porridge and milk, each costing 1½d. He finds that the total energy of the bread and butter and tea meal is only 950·6 Calories, while the total energy of the porridge and milk meal is 1,133 Calories.

Rice.

Rice is the staple food of the Chinese and Japanese and of many other Eastern people. As sold in this country, it lacks the rice-meal which lies normally under the husk, and is poorer, therefore, in proteins and phosphates than the natural rice. The composition of boiled rice as used in the West is given by Atwater and Woods as follows :—

COMPOSITION OF BOILED RICE

Water	52·7	per cent.
Protein	5·0	,,
Fat	0·1	,,
Carbohydrates	41·9	,,
Mineral matter	0·3	,,

Owing to deficiency in protein and fat, rice is not a good tissue builder. It is, however, highly absorbable, and is a useful article of diet where it is desirable that there should be little intestinal residue.

Potatoes.

Potatoes constitute a very important item in the dietary of civilised nations. Their characteristic features are the large quantities of starch and the variety of mineral salts they contain. The composition of a potato is given by Payen as follows :—

COMPOSITION OF A POTATO

Protein and other nitrogenous matter	2·50	per cent.
Starch	20·00	,,
Cellulose	1·04	,,
Sugar and gummy matter	1·09	,,
Fatty matter	0·11	,,
Pectates, citrates, phosphates and silicates of lime, magnesia, potash, and soda	1·26	,,
Water	74·00	,,
	100·00	,,

Like most other vegetable foods, potatoes are seen to be deficient in protein, and they are therefore best taken in combination with protein foods, such as meat or buttermilk. It is possible, as was shown in certain prison experiments, to sustain life on potatoes alone, but in such a case it is necessary to take about 5 pounds of potatoes a day —a quantity liable to distend the intestines and produce so-called "potato belly."

The digestibility of potatoes depends largely on the character of the potato used, and the way in which it is cooked. Mealy potatoes are much more digestible than waxy potatoes, but on the other hand the waxier potatoes contain more protein. Owing to the citrate of potassium they contain, potatoes are valuable preventives of scurvy. From the standpoint of economy they are one of the *cheapest* foods. Probably an acre of land will produce more nutriment in the form of potatoes than in any other form, except chestnuts or bananas.

Nuttall states that the same ground gives 33 pounds of wheat, 99 pounds of potatoes, and 4,000 pounds of bananas.

Turnips, carrots, and parsnips contain little absorbable nutriment in proportion to their bulk. A turnip, indeed, is 90 per cent. water.

Green Vegetables.

Green vegetables have very little nutritive value. They contain, however, abundance of cellulose, which acts as a stimulant to the bowels, and they are rich in alkaline salts, and are therefore useful as preventives of scurvy and in cases of gout and gravel. They are apt to ferment in the bowels, and should be avoided by those subject to flatulence.

The pulses (peas, beans, lentils, peanuts), unlike other vegetables,

are characterised by the large amount of protein they contain. The following table, giving the composition of beans, peas, and lentils, is quoted by Sir Risdon Bennett in "The Book of Health":—

Pulses.

COMPOSITION OF BEANS, HARICOT BEANS, PEAS, AND LENTILS

	Dried Green and Skinned Broad or Winter Beans	*Haricot or French Beans*	*Peas, Dried*	*Lentils*
Nitrogenous matter .	29·05	25·5	23·8	25·2
Starch	55·85	55·7	58·7	56·0
Cellulose . . .	1·05	2·9	3·5	2·4
Fatty matter . .	2·00	2·8	2·1	2·6
Saline matter . .	3·65	3·2	2·1	2·3
Water	8·40	9·9	8·3	11·3

Highly nutritious though the pulses are, they are hardly so valuable as at first sight might appear; for, except when fresh and young, they are not very readily digested and absorbed. They are also apt, owing to the sulphur they contain, to cause flatulence. They contain, too, a considerable amount of a uric-acid forming substance called "xanthin," and must, therefore, be avoided by those with gouty tendencies. Owing to the large quantities of lime they contain, they might with advantage be added to the diet of rickety children.

Fruits.

Almost all fruits contain a large proportion of water, 85 to 93 per cent., a fraction per cent. of protein, and 5 or 10 per cent. of carbohydrates. Their nutritive value is, therefore, not great. Owing to their appetising flavours, however, many are digestive stimulants, while the salts of potash which they contain are useful as anti-scorbutics and to render the blood alkaline.

A few fruits—bananas, dried apples, dates, figs, prunes, currants, raisins—have considerable nutritive value. Most of these owe their nutritive value to the easily assimilated fruit sugar they contain, but bananas consist almost entirely of starch. Figs, raisins, and dates are especially nourishing, and, weight for weight, dried figs are more nourishing than bread. A pint of milk and 6 ounces of dried figs make a good meal.

Nuts occupy a class by themselves, for they contain, in small compass, a large quantity of nutritive material—more nutritive material, bulk for bulk, than any other natural article of food. Almonds, for instance, contain 24 per cent. of protein, 54 per cent. of fat, and 10 per cent. of carbohydrate, while dried walnuts contain 15 per cent. of protein, 62 per cent. of fat, and 7 or 8 per cent. of carbohydrate. Chestnuts are notable in that they contain a large percentage—71 per cent. in the dried nut—of carbohydrate.

Nuts.

Owing to the quantity of oil they contain, nuts are good fuel-food, and furnish heat and energy. They are, however, difficult to digest, owing chiefly to the cellulose they contain; and unless the teeth are good they should be ground before being partaken. Various preparations of nuts, crushed in order to facilitate digestion, are sold.

It is possible to live entirely on nuts, and there is a school of dietetics that commends an exclusive nut diet. It has yet to be proved, however, that there is any advantage in such dietetic exclusiveness.

Sugar is a form of carbohydrates allied to starch, and occurring in various forms in animal and vegetable tissues. It occurs in milk as lactose, in muscle as inosit, and it is found in large quantities in the sugar-cane, in beet, and in many fruits. There are two main classes of sugars—the sucroses, of which beet and cane sugar are representatives, and the glucoses, exemplified by honey and by the sugar of fruits. The glucoses are more readily assimilable than the sucroses—indeed, the sucroses have to be converted into glucoses before they can be assimilated.

Sugar.

Sugar is a very cheap concentrated fuel-food, and is readily burnt up in the body, furnishing heat and energy. It is of chief importance as a source of muscular energy, and of late years many experiments have been made to prove its value in this respect.

The craving of children for sweets and sweet things is probably founded on this dietetic fact—on a physiological craving for concentrated fuel to maintain their constant muscular activity.

Unless in too concentrated solutions, or in excessive amounts, sugar is readily assimilated without digestive disturbance.

Meat is essentially a protein food; it consists mainly of water and protein, with a varying amount of fat, extractives, and mineral matter.

The proteins of meat are myosin, muscle albumin, and hæmoglobin; and the first of these is the most important. Meat contains—if we except liver and kidney—no carbohydrate, and is therefore rightly and usually eaten with carbohydrate food, such as bread and potatoes.

Meat.

AVERAGE COMPOSITION OF MEAT (KÖNIG)

Protein	18·36 per cent.
Gelatine	1·64 " "
Fat	0·90 " "
Extractives	1·90 " "
Ash	1·30 " "
Water	75·90 " "

When we compare meat protein with vegetable protein, we find that each has its advantages and disadvantages. Meat protein is associated with meat extractives, which, as Pawlow has shown, stimulate the flow of the digestive juice. On the other hand, these very extractives tend to form uric acid, and according to Haig are the cause of fatigue and the source of many diseases.

It is probable that most people in good circumstances eat more meat than is necessary for the building up of their tissues, and that the excretion of the *débris* of the superfluous protein puts undue strain on their kidneys. Chittenden has shown that very little protein is really necessary, and that the belief in meat as a source of muscle energy is merely a superstition. To supply all the energy an active man uses, 4 or 5 pounds of meat a day would be required, and the same energy can be supplied much more economically in the form of proteins. Meat, when tender and well masticated, is easily digested and well absorbed, and leaves little residue in the intestine. It is more easily digested and absorbed when raw than when cooked.

The comparative digestibility of different kinds of meat has not yet been conclusively established. It is probable that beef and mutton are more digestible than lamb, and that mutton is more digestible than beef; but individual differences, both in the food and in the feeder, must be allowed for. Veal is usually considered indigestible, but if it is well masticated it will be found to be digestible enough. Pork, owing to the fat permeating its fibres, is certainly hard to digest, and should be avoided by those with weak digestions.

Poultry and Game. The flesh of birds has long had a reputation for digestibility. The digestibility depends firstly on the tenderness of the flesh, and secondly on the freedom of the muscle fibres from fat. The flesh of game birds is particularly free from fat, and has, in addition, appetising flavours.

Fish. The nutritive value of fish varies with the amount of fat it contains. A fat fish like the salmon or the herring has much more nutritive value than a lean fish like the sole. On the other hand, the leaner fishes are usually the more readily digested. Weight for weight, fish is not so nutritious as meat, and owing to lack of extractives it is not so appetising; but from an economical standpoint some of the cheaper kinds are a much more economical source of protein.

The idea that since fish contains phosphorus it is nourishing to the brain is merely a popular superstition, as has been pointed out in an earlier chapter; but, because of the less strain it puts on the excretory organs, it is a particularly suitable food for brain workers leading sedentary lives.

CHAPTER LXXXVII

WATER AND MINERAL SALTS

Water—Soups—Tea—Coffee—Cocoa and Chocolate—Mineral Salts.

So far, we have considered merely the main food-stuffs—proteins, carbohydrates, fats—and their combinations; but water and the mineral salts are also essential to life and activity, and must therefore be considered as food.

WATER

Man is about two-thirds water, and this part of him requires constant renewal, for it is constantly depleted by evaporation and excretion. Under ordinary conditions 4 or 5 pints of water are abstracted from the body daily, while under some extraordinary conditions of heat and exercise as much may be lost in a few hours. A certain amount of the water lost is restored by the water contained in the solids of the food—a turnip, for instance, contains fully 90 per cent. of water—but in addition, water in some liquid form must be taken, and usually at least 2½ pints of beverage are required daily.

If too much water be taken either in the solids of the food or as beverage, the excess permeates the tissues, and they become watery. If, again, too little water be taken, the blood becomes unduly thick and will not flow freely. It is therefore desirable that fluids should be consumed discreetly and judiciously.

In cases of heart disease, it is often necessary to restrict the consumption of fluid, since any excess of blood, even temporary, will give the heart superfluous labour. In cases of gout, diabetes, and fevers, on the other hand, it is desirable to give large quantities of water to dissolve and wash out poisonous matters.

Too little fluid in the diet is one of the commonest causes of constipation.

The question of the time at which fluid should be drunk has been

much debated. It is sometimes said that water should not be taken with meals, because it dilutes the gastric juice. As a matter of fact, water rather stimulates the secretion of the gastric juice, and drinking water before or during a meal is quite sound dietetic policy, provided always it is taken not too cold nor in too large quantities. It is perhaps best taken in the form of soup, at the beginning of a meal. A draught of warm water before a meal, or some hours after a meal, stimulates the muscular movements of the stomach and clears out of it any stagnating products.

Since water is a carrier of infection, every care should be taken to obtain a pure supply, and if there be any suspicion of pollution the water should always be boiled or filtered before use. Care, too, should be taken that the water does not contain lead in solution.

As a rule, water is taken not in its natural condition but in the shape of soup, tea, coffee, cocoa, chocolate, and alcoholic beverages, and we shall now briefly discuss these, except alcoholic beverages, which are treated of in the next chapter.

Soups.

Soup is at once a food, a stimulant, and a source of fluid to the body. As a food it has little nutritive value. Even a rich soup contains little nutrient material, and the value of soup depends chiefly on its stimulating properties and on the fluid it supplies. We have seen how extract of meat provokes the secretion of gastric juice, and a soup containing meat extract is the best possible prelude to a solid meal.

Meat extract, and meat juices, and ordinary beef-teas are really forms of soup, and their chief value depends on their power of stimulating gastric secretion. It is the greatest mistake to imagine that beef-teas and meat extracts are nourishing and strengthening. The nourishment they contain is very small, and if they are given as food their nutritive value should be increased by the addition of more nourishing material, such as baked flour or white of egg.

Tea.

Tea is perhaps the most popular beverage in the world. It varies in its precise chemical constitution and flavour with the particular kind of tea-leaf used. The most characteristic constituents are tannic acid, an aromatic volatile oil, which gives aroma and flavour to the infusion, and an alkaloid called "theine." Indian and Ceylon teas contain more tannin than Chinese teas, and green teas more tannin than black teas. Tea itself contains practically no nutrient material; but when milk and sugar are added its nutritive value becomes considerable.

Tea is usually taken simply as a stimulating and pleasant beverage. It owes its stimulating properties to the theine it contains. Theine is a stimulant both to the heart and to the nervous system. It removes fatigue and promotes intellectual activity, and it also increases the action of the kidneys and skin. A teacupful of average tea contains about 1 grain of theine and about 3 grains of tannic acid.

Tannic acid is a strong astringent, retards digestion, and in some cases may produce indigestion. If tea be quickly infused, however, it will contain comparatively little tannic acid.

In moderate quantities and rightly prepared, tea is a wholesome beverage, but when consumed in excess, or when taken in too strong infusions, it may cause nervous agitation or dyspepsia. John Wesley, writing in 1748, describes his experience of tea as follows: "I could not imagine what should occasion the shaking of my hand till I observed that it was always worst after breakfast, and that if I intermitted tea drinking for two or three days it did not shake at all. Upon inquiry, I found that tea had the same effect on other persons of my acquaintance, and therefore saw that this was one of its natural effects, as several physicians have often remarked, especially when it is largely and frequently drank, and most of all on persons with weak nerves. . . . I began to observe that abundance of the people in London with whom I conversed laboured under the same and many other paralytic disorders, and that in a much higher degree, inasmuch that some of their nerves were quite unstrung, their bodily strength quite decayed, and they could not go through their daily labour."

In the Colonies, where tea is boiled on the fire in a pan, and where it is drunk in large quantities, it exercises a most pernicious influence on the health. When taken with potatoes it will often cause indigestion and flatulence, and many cases of gastric disturbance among the poor are due to this injudicious combination.

Coffee.

Coffee, like tea, is a stimulating beverage. Its characteristic constituents are an aromatic oil and an alkaloid called "caffeine," which is practically identical with the alkaloid "theine." Unless when taken with sugar and milk, coffee has almost no nutritive value. Like tea, it stimulates the kidneys and skin, and, even more than tea, it is a stimulant to the nervous system and to the heart. It retards digestion less than tea, but sometimes causes digestive disturbance. In excessive amounts it causes muscular

tremors, sleeplessness, or palpitation. Coffee is often adulterated with chicory.

The alkaloid of tea and coffee is a source of uric acid, and therefore these beverages should be forbidden in cases of gout. Cocoa is often regarded as food, but its food-value is very small, and it is really a stimulating beverage like tea and coffee. Chocolate, unlike the former three beverages, has considerable nutritive value, and Dr. Hutchison estimates that "$\frac{1}{2}$ pint of milk and 2 ounces of chocolate yield together fully 400 Calories, and $3\frac{1}{2}$ pints would suffice to supply all the energy and a large part of the building material required in a day."

Cocoa and Chocolate.

Quite apart from the stimulating and nutritive properties of these beverages, their importance as a source of water to the system must not be overlooked.

MINERAL SALTS

Though mineral salts do not seem incorporated in the living protoplasm of the tissues, yet they are essential to vital action, and are continually excreted and replaced. The most important and plentiful mineral substances of the body are sodium, potassium, calcium, magnesium, iron, phosphorus, sulphur, chlorine; and food must contain these if health and energy are to be maintained. In ordinary food they are all found, and in so called "mineral" waters certain of them occur more or less plentifully. As a rule, the mineral substances in ordinary food suffice for the needs of the organism; and when there is a deficiency of any mineral substance in the body, the deficit is usually due not to deficient supply, but to inefficient assimilation. Thus children suffer from rickets through deficiency of lime salts in their bones, and anæmia is due to deficiency of iron in the blood; but in most cases there is plenty of lime salt and plenty of iron in the food, and the tissue defect is due to inefficient assimilation.

In ordinary life it is usual to add salt to food, but except in the case of vegetarians the addition is quite unnecessary.

CHAPTER LXXXVIII

STIMULANTS AND NARCOTICS

Why Stimulants and Narcotics are Taken—Alcohol—Ether—Absinthe—Ammonia—Tea, Coffee, Cocoa—Opium—Chloral—Sulphonal, Trional, Veronal—Cocaine—Paraldehyde—Tobacco.

By *stimulants* we mean substances which, if taken, appear to increase the vital processes for the time being, and give a sense of pleasure and exhilaration. By *narcotics* we mean substances which, if taken, seem to decrease the vital processes for the time being, and give a sense of depression and a feeling of lessening one's relationship with the influences of the external world ; taken in large doses, they abolish all the mental faculties and cause torpidity.

Why Stimulants and Narcotics are Taken.

It may seem strange that people should require either stimulants on the one hand or narcotics on the other. Where is the necessity for either ? No doubt the answer to this question lies very largely in the fact that we do not live a natural life. Civilisation has surrounded us with such a network of circumstances of an artificial kind that it is very difficult—nay, almost impossible—not in some way to come under its influences. Instead of enduring pain or even a moderate degree of discomfort, people call aloud for relief, and, instead of being content calmly to pursue the even tenour of their way, they require constant stimulation to keep them up to the mark and prevent depression.

Stimulants are usually taken with the object of obtaining pleasure, whilst narcotics are taken with the object of avoiding pain or discomfort, whether of body or mind ; often, too, with the intention of procuring sleep. Although stimulants and narcotics are thus diametrically opposed one to the other, it must always be remembered that large doses of stimulants usually have a narcotic effect. Thus a moderate dose of alcohol will cause a sense of exhilaration and temporarily stimulate the faculties ; whilst a bigger dose will render the individual

dead drunk. Again, small doses of narcotics often act as stimulants. Thus, a small dose of opium may cause wakefulness and excitement, whilst a large dose will produce profound narcosis.

Of course, speaking in a general way, all foods, and even substances which are not foods, introduced into the stomach act as stimulants to that organ ; a glass of cold water, slowly sipped, acts as a powerful stimulant to the circulation, and a cup of strong beef-tea is one of the best stimulants known. But our concern is with the stimulants and narcotics which are used almost exclusively as such.

The chief stimulants are : Alcohol in all its forms (as occurring in beer, wines, brandy, gin, whisky, liqueurs, etc.), absinthe, ether, ammonia (sal-volatile), tea, coffee, and cocoa.

The chief narcotics are : Alcohol in all its forms, opium (morphia), chloral, sulphonal, veronal, trional, cocaine, ether, chloroform, paraldehyde, tobacco.

ALCOHOL

By far the most important and the commonest stimulant and narcotic is alcohol ; it will therefore be best to enter somewhat in detail into the action and effects of alcohol upon the human body. Whether alcohol is a real food or not has long been a vexed point, but there can be little doubt that alcohol is a food, though a very poor one, and one very inconvenient for the tissues to assimilate.

Is it a Food?

A large dose of alcohol in a very short time quickens the action of the heart and lungs, and at the same time dilates all the smaller blood vessels of the skin, producing a sensation of flushing and warmth, and seems to urge on all the processes of life, causing a sense of pleasure and exhilaration. With some persons this sense of pleasure is much more marked than others. The lower faculties, such as the emotions and imagination, are more active than usual, but this seems really to be due to the inhibition of the higher nerve centres being removed, and the person, though appearing more loquacious and jocose, has at the same time his judgment and sense of proportion impaired. Next he gets dull and stupid, being inclined to sleep : the narcotic effects are beginning to appear. Next his motor centres become affected, and he is unable to walk straight, but reels about, although he may be able to ride quite well. Next sensation becomes abolished. The knowledge of this fact was utilised in pre-anæsthetic days, the patient often being rendered dead drunk before the performance of an operation. Last

of all, if a fatal dose be taken, the nerve centres of respiration and circulation become paralysed, and so death ensues. It is curious that a man may become drunk in his head and not in his limbs; thus a coachman may be so drunk as to be quite unable to answer any question addressed to him, and yet be able to drive through crowded streets with the most perfect certainty of steering his way successfully between all obstacles.

Alcohol influences the tissues as (1) a stimulant, (2) a narcotic, (3) an anæsthetic, (4) a paralytic, so acting in much the same way as chloroform and ether.

Long-continued overdoses of alcohol act as a slow poison to all the tissues of the body, and may produce disease in any or all of the organs, the parts specially affected being the stomach, liver, brain, and nerves. It is a well known fact that those who are most exposed to the influence of alcohol are those who are placed at the bottom of the list in expectation-of-life tables. Pure alcohol of itself is not nearly so injurious as the substances often found associated with it, such as fusel oil, etc., in the cheap spirits. Also the different forms of alcohol found in spirits and wines have somewhat different actions, partly on account of their different strengths, but partly also from the additional ingredients which wines, beers, etc., contain. As a rule, the greatest harm is done by spirits, and the least by weak wines and small beer. The drunkenness caused by spirits is apt to be furious, that by wine gay, and that by beer stupid.

All present-day researches go to prove that alcohol in any form, as a regular thing, is not only unnecessary but injurious in the case of healthy young people. Middle-aged persons are, as a rule, better without alcohol as an article of diet, although a glass of ale or cider does not seem to do any harm. With old people, whose tissues do not respond quickly to the usual stimulants, a small dose of alcohol with food will often assist digestion and promote sleep. Alcohol should therefore be regarded as a drug, not as an article of diet. Pure malt liquors contain very little alcohol, and afford a certain amount of nutriment, but should be taken, if at all, with meals. Of course, even here moderation must be observed. The present writer well remembers a man presenting himself for insurance who, on being asked what he drank, stated that he always drank the same amount—viz. fourteen glasses of ale daily, except on Sundays, when he had water. He did it merely in a business way,

and was quite surprised to hear that the quantity was considered too much, and he at once reduced it. This habit of taking drinks over business transactions cannot be too strongly condemned; many a young man has been utterly ruined through "nipping" brandy, whisky, or liqueur with customers, until a habit is formed which it is difficult and often impossible to shake off. Repeated "nipping" on an empty stomach rapidly proves fatal.

How common is it for a man to come home fagged and "done up" with his work and sit down at once to his dinner, disgusted with his food, and sure of having a fit of indigestion for hours afterwards. By taking a glass of brandy or a liqueur before his meal he finds that he feels much more comfortable, and is able to enjoy his food without any subsequent discomfort. But this is a bad way to go to work. His organs are tired and fagged out. He should insist on having a rest before dinner to allow the tissues to recuperate themselves, and if he is obliged to take something, half a cup of beef-tea will do all that is required.

Effect upon the Body Heat.

Alcohol, by stimulating the heart and dilating the small blood vessels, and by this means producing a glow and sense of warmth, would appear to increase the body heat. This, however, is not the case. In fact, the very opposite effect ensues; the body heat is lessened, and this fact is turned to account in fevers, where alcohol is often given to reduce the temperature. In a well known instance a party of explorers were obliged to camp out on a very cold night. Some of the party took a good stiff dose of spirits and went to bed warm and happy; others took a small dose and were not so comfortable, whilst the remainder took no alcohol, and turned in cold and miserable. When morning came the first batch never woke at all—they had been frozen to death; the second woke shivering and wretched; whilst the last were fit and ready for their day's work. On the moors it is no very uncommon thing for the keeper to refuse "a pull at the flask" on the ground of its being too cold a day. In Polar expeditions alcohol is now never used as an article of diet.

Alcohol, as we have hinted, does most harm when taken on an empty stomach, and least when taken with food. Much exercise in the open air greatly lessens its poisonous effects. The local effects of alcohol are best seen by its action on the mucous membrane of the mouth.

Pure brandy, for instance, retained in the mouth for a short time causes a sensation of burning, and whitens the inside of the cheek owing to its property of coagulating albumen; at the same time it causes a copious flow of saliva in a reflex way by stimulating the orifices of the salivary ducts. The morning after too great indulgence in spirits the mouth and tongue are apt to be very dry, due, no doubt, to the excessive stimulation of the salivary glands that has taken place.

Local Effects.

If we follow the alcohol into the stomach we find the same effects ensue. There too it produces a sensation of warmth, and the mucous coat of the stomach—if a large dose of pure spirits be taken—becomes white. In small quantities, however, the effects are quite different. By reflex action the blood vessels of the stomach dilate, and the mucous membrane becomes rosy red, and secretes gastric juice, which stands in beads on the surface, soon to coalesce and run along in tiny streams. This course of events takes place on any slight stimulus being applied to a healthy stomach. But if the stimulus be too powerful or the stomach unhealthy, the result will be quite different. The vessels, instead of dilating, become contracted, and the mucous membrane pale, the secretion of gastric juice is stopped, and thick, stringy mucus is secreted, which will set up nausea and vomiting. The digestive element of the gastric juice is pepsine. Now alcohol has the property of precipitating pepsine and thus destroying its digestive power, which explains the reason why persons addicted to alcoholic excess suffer from nausea and loss of appetite. In cases of delirium tremens it is no uncommon thing for the patient to vomit quite undigested food which had been taken several days before.

Chronic alcoholic excess gradually leads to a deterioration of the whole system, and it is quite common for this to occur in persons who have never been intoxicated in their lives. The small blood vessels of the face—especially of the nose—become permanently dilated, giving a rubicund appearance, and the whole face becomes bloated. The tongue is furred, the breath offensive, appetite is lost, and vomiting, especially in the morning, sets in. The stomach, liver, kidneys, and nervous system become affected, and dropsy is apt to occur.

Effect of Chronic Alcoholism.

We will now consider briefly the chief causes which lead to intemperance. No doubt habits of intemperance are often acquired from taking

spirits to relieve pain. Colic, spasms, indigestion, internal cramp, and the periodical disturbances of the organism to which women are subject, are often quickly relieved by a strong dose of alcohol. Gradually the taste for it becomes acquired, until the habit cannot be broken off.

Causes of Intemperance: Pain.

Many are led to drink in order to stupefy themselves and forget their adverse circumstances, or, as it is put, "to drown dull care." No doubt the effect of alcohol is to give temporary pleasure and forgetfulness of sorrow, but it is a pleasure very dearly purchased, as it increases the misery afterwards and is followed by greater depression. Cold and want would certainly fall under this heading as important actors.

Misery.

A savoury meal is much more digestible than an unsavoury one. A savoury smell makes the mouth water owing to the stimulation of the salivary glands, and this in turn causes an increased secretion of gastric juice. Badly cooked food will often cause disgust and nausea, resulting in indigestion, flatulence, and acidity. How often is it the case that bad cooking sends a man off to get his dinner at the club or restaurant! Indifferent food causes a sense of want of stimulation, which is relieved by a glass of wine or spirits.

Bad Cooking.

Many people suffer from melancholy, nervous depression, and a sense of heaviness or weakness, especially about two or three hours after a meal, and find relief from taking a nip of brandy or glass of port wine. The relief, however, is only temporary, and the remedy is repeated several times a day, with the same results. Now a fire may go out from two causes, either from being choked up with ash or because it needs fuel. If the depression arise from lack of nourishment, it is not a stimulant that is required, but food. But the majority of persons eat too much—not too little; they are choked up with ash. Instead of combating their sense of weakness by eating more frequent meals and taking stimulants, they should practise strict moderation in diet, and take saline aperients and active exercise.

Depression.

Alcohol has often been taken with the idea of enabling a person to endure extra fatigue, but it is a rule that ought never to be broken that spirits should not be drunk whilst undergoing any exertion, but only, if at all, when the exertion is over. On a long march the first effect of alcohol on the soldiers is reviving, but the effect is but

Fatigue.

transient, and after a couple of miles the previous sense of exhaustion will not only return but be intensified. If alcohol be again resorted to the reviving power is not nearly so marked, and the after prostration will be much more pronounced. A man is never such a good shot after having a dose of spirits.

Some persons who suffer from sleeplessness find it relieved more readily by a glass of hot spirits and water than by anything else. During sleep there is a scanty supply of blood to the brain. We all know the sense of drowsiness that is apt to steal over one after a heavy meal; the blood vessels of the stomach and liver become engorged, leaving the brain anæmic. Now a glass of hot spirits taken at night dilates the vessels of the stomach, and draws away the blood from the head. Unfortunately, alcohol stimulates the heart and dilates the general blood vessels, so that if it does not cause sleep it may make the person more wakeful than he was before. The best way to combat sleeplessness in these cases is to take a cup of hot beef-tea, put a warm compress over the abdomen, and have a hot-water bottle for the feet.

Sleeplessness.

To sum up, we may say concerning alcohol that—

It is a valuable medicine.

Young and healthy persons do not require it, and are much better without it.

In moderate quantity it may in some cases aid digestion, though in some persons digestion is interfered with by its use.

In elderly persons the moderate use of wines or spirits with food appears to do no harm.

Those persons in whom the pleasurable symptoms produced by alcohol are most marked are in greatest danger of being led into excess.

Alcohol does most harm on an empty stomach, and least when taken with food.

OTHER STIMULANTS

In most of its effects ether resembles alcohol, but acts more quickly, and its results pass off more rapidly. It is in manufacturing towns that it is most often taken as a stimulant.

Ether.

Absinthe is a very powerful stimulant, and when given in large doses

does not produce narcosis and depression, like alcohol, but sets up epileptiform convulsions. It acts chiefly upon the nervous system.

Absinthe.

Ammonia is usually taken in the form of sal-volatile. If drunk in too large a quantity it tends to cause nausea and vomiting. This it is much more prone to do than spirits, which acts as a bar to its being commonly used in excess.

Ammonia.

Tea, coffee and cocoa are used nearly the whole world over as every-day drinks. The active principle is almost identical in all three, and they are all stimulants, though not in the same degree, and unlike alcohol the stimulation is not followed by any marked depression. Something has been said about them in the preceding chapter, but we may here add a few details of a practical character.

Tea, Coffee, Cocoa.

Tea should be prepared as an infusion, and not as a decoction—*i.e.* boiling water should be poured upon the leaves and allowed to stand for a very short time before being poured off. Among the Chinese it is only allowed to stand for a few seconds. When long infused a large quantity of the tannin is extracted, which is liable to cause dyspepsia. It is certain that dyspeptics should avoid tea along with, or shortly after, animal food. Cold tea makes a capital beverage in hot weather. The kind of tea taken makes a great difference to some. Thus many can take China when unable to take Indian tea. When drunk in excess it is apt to set up muscular tremors, giddiness, palpitations, and wakefulness. A cup of hot, strong tea or coffee is often useful in dissipating a headache.

Coffee should be prepared fresh, or the volatile oil which it contains will be lost, and its flavour impaired. Its action upon the nervous system is of an invigorating and yet soothing nature. With some persons it is more apt than tea to set up digestive trouble and palpitation of the heart. When taken in excess it produces irritability, nervousness, palpitation, and sleeplessness. It is a bad habit to take either coffee or tea before retiring to rest. Both contain ingredients which in the system are converted into uric acid.

Cocoa is a mild stimulant, but is slightly nutritive. It is prepared in different ways : broken in pieces and the husk removed and sold as cocoa nibs, simply ground up and sold as an essence of cocoa, or mixed with starch and sugar. It is also ground, after being shelled,

into a paste, mixed with sugar, seasoned, and dried, and is then styled chocolate. Cocoa contains about half its weight of fat, which is known as cacao butter. This, though very nourishing, is not very easy to digest, and in the different manufactured cocoas is removed in various degrees.

At night, if a stimulant be required, nothing could be better than cocoa or hot milk, which will often induce sleep, whilst tea or coffee will usually cause wakefulness.

NARCOTICS

We have already considered the chief narcotic, which is alcohol, and we will now look at a few of the commoner substances which are taken as pure narcotics. Of course, opium easily heads the list.

Opium.

Opium contains several alkaloids, such as morphia, codeia, etc., which have the properties, in varying degrees, of producing sleep or causing convulsions. Now opium, unlike alcohol, has no local action worth speaking of. When swallowed it diminishes secretion and lessens the movements of the stomach and bowels, and thus allays colic and diarrhœa. The effects of opium are produced by its action, after absorption by the blood, upon the various nerve centres, and entirely depend upon the amount of opium in the blood at any given time. If absorption be quick and excretion by the kidneys slow, the effects will be proportionately great, and *vice versâ*. This explains why persons with kidney disease stand opium so badly. Children also are very easily affected by this drug, and one drop of laudanum has been known to prove fatal to an infant. At one time it was a common thing for farmed-out babies to be kept quiet by a little opium, and many have been slain in this way by the so-called "angel-mongers."

A moderate dose of opium first of all stimulates the brain, the person being enabled to think more clearly and talk with greater brilliancy than is natural to him. This stimulation and sense of enjoyment soon, however, pass off, to be followed by great—in fact, unconquerable—drowsiness. If a large dose be taken the stage of stimulation is short, and the person falls into a state of coma, from which it may be impossible to rouse him, and death may take place from paralysis of the respiratory organs.

Opium is used for three distinct purposes—to produce sleep, to relieve pain, to afford pleasure. In whichever of these ways opium is used,

there is always great danger of the person contracting the opium habit. Sleeplessness is one of the banes of our so-called highly civilised lives, and it is a great temptation to some people to take a few drops of opium or a small injection of morphia, which will, they know with certainty, give them a good night's rest. But how much greater is the temptation when sleeplessness is combined with acute pain, knowing all the time that a hypodermic injection of morphia will not only relieve the pain like magic, but afford a positive sense of pleasure and delight, to be shortly followed by calm, refreshing sleep! Is it any great wonder that the dose is repeated the next night, when the pain comes on again? Soon, however, the sufferer finds that more and still more of the drug must be taken to obtain the desired results, and the opium habit becomes fully confirmed.

Opium may be taken simply for its stimulating effects, either by drinking the fluid or inhaling the vapour from a pipe in the form of smoking. The stimulating and pleasurable effects are, however, soon followed by depression, to counteract which more and more of the drug is taken. As the habit becomes confirmed the period of excitement diminishes, and the miserable after-effects of depression become more marked, and at length so much is this the case that the habit is continued rather for the negative purpose of avoiding depression for a time than for the positive one of obtaining pleasure.

In the opium habit the nervous system suffers greatly; the mental powers become enfeebled, and all the moral faculties are utterly perverted. There is dryness of the mouth, thirst, complete loss of appetite, nausea, and vomiting.

Opium, or any of its preparations, should never be taken except under medical advice.

Chloral.

Unlike opium, chloral has very little power to relieve pain, although sleep induced by its use is more natural, and is not followed by the same disagreeable after-effects, the person awaking bright and refreshed instead of suffering headache, nausea, and sickness, as after opium. Of late this drug has been largely used by persons suffering from nerve irritability and sleeplessness, on their own account and not on a doctor's advice, under the impression, which is quite a false one, that the drug is free from any sort of danger. Chloral is really a very dangerous drug. An overdose produces deep sleep, passing into coma from which it is impossible to rouse the person; the pulse and

breathing get weaker and weaker, and death ensues. An habitual use of chloral leads to an eruption on the skin, and shortness of breath, especially noticed on going upstairs, the mental powers become impaired, until the condition becomes one almost of imbecility, and abscesses are apt to form in various parts of the body.

Sulphonal, Trional, Veronal.

Sulphonal, Veronal and Trional are closely allied. They are pure hypnotics, and have no influence over pain. Sulphonal is, perhaps, the preparation most commonly used of the three by the laity. In these days people seem to think nothing of going to a chemist and ordering a bottle of tablets or cachets of one of these drugs under the impression that if they do no good, at least no harm can come of it. Yet they are all more or less dangerous, and should never be taken unless under medical advice. Sulphonal is the most slowly absorbed into the system, and is also the most slowly excreted. Its continued use causes a destruction of the colouring matter of the blood, and the urine assumes a cherry red colour. Several deaths have been caused by persistent indulgence in this drug.

Cocaine.

Cocaine has an anæsthetic effect on all parts of the mucous membrane when applied locally. But it is also taken—especially in France—for its exhilarating effects, a hypodermic syringe being commonly used for its administration. When taken internally it acts as an excitant of the whole nervous system, causing great mental activity and a sense of exhilaration. This stimulation is followed by faintness, headache, and a tendency to syncope and breathlessness. The prolonged use of the drug produces emaciation, rapid pulse, loss of memory, sleeplessness, and delirium. When once the drug habit is acquired an intolerable craving for it seems to be set up, which it is extremely difficult to eradicate.

Paraldehyde.

In spite of its disagreeable odour, paraldehyde is sometimes resorted to in order to induce sleep. It has no stimulating effect. Its prolonged use irritates the digestive organs.

Tobacco.

The use of tobacco in the form of smoking, chewing, or snuffing is pretty well world-wide. The active principle is nicotine, which in itself is a deadly poison, but if heated undergoes changes into various volatile alkaloids. That tobacco has a powerful effect upon the system is easily demonstrated by one's "first cigar," which produces the well-known symptoms of pallor of the face, faintness, giddiness, nausea, and vomiting. It is, however, remarkable how quickly habit

overcomes all this, and that which was at first so detestable becomes tolerable, next enjoyable, and at length indispensable. But even those who are quite habituated to tobacco very quickly perceive the effects of an overdose, which will betray itself by muscular tremors, unsteadiness, and wakefulness. Tobacco acts chiefly on the nervous system, and especially on the nerves of the heart, causing that organ at first to beat slowly, and then putting it out of rhythm, so that there is marked irregularity along with excitement, a condition of things known as "smoker's heart." Nearly all persons who have smoked to excess when young are forced to moderate the use of tobacco in later years on account of nerve disturbances. Excessive smoking is liable to set up a dry, irritable condition of the throat, leading to constant "hawking" and spitting. The eyes are also often affected and acuteness of vision is greatly diminished. This may go on to total loss of sight, as we have shown elsewhere. Smoking in moderation seems to have a general soothing effect and to give an undefined feeling of pleasure, and when indulged in wisely may be continued through a lifetime without any injurious effects. In some persons it seems to aid digestion and promote regularity of the bowels. Occasionally tobacco causes a profuse flow of saliva, and such sufferers are constantly obliged either to swallow or to expectorate; thirst is thus induced, which is only too often relieved by alcoholic drinks. Thus smoking and drunkenness are sometimes combined.

Lads under eighteen should not smoke at all. The habit has a bad effect upon the immature nervous system, and tends to stunt development. The worst form in which tobacco can be smoked is that of the cigarette, and the best that of the long pipe. Smoking should never be indulged in on an empty stomach. The time to reserve it for is after the evening meal, when the day's work is over. The smoke should never be swallowed or inhaled. We need hardly add that the habit of chewing tobacco is both harmful and disgusting.

CHAPTER LXXXIX

ABOUT HOLIDAYS

An Idle Holiday—The Man who Needs no Holiday—The Overworked Man—Worrying Work—Monotonous Work—Short Holidays—Holidays for those who have too much Play—Walking, Bicycling, Motoring, Riding, and Boating Tours—Sea Voyages—Railway Tours—Fishing and Shooting.

A HOLIDAY was originally a *holy* day—a day when the spirit was healed and made whole; but in modern, more materialistic times a holiday has come to mean mainly and particularly a day of freedom from work. Yet, though the term has changed in its main meaning, a holiday may still be a day of healing, and holidays are still of therapeutic import.

Relaxation is the guardian of elasticity; rest is the root of energy. "The bow that is always bent breaks," and "All work and no play makes Jack a dull boy." Even a razor requires a rest if it is to keep its edge keen. A holiday, accordingly, which means freedom from work may also mean accumulation of energy and recuperation of working capacity. Even the holiday taken apparently simply from a desire for play may yet be instigated by sound physiological instinct. The desire to "kick over the traces" is often an indication that the harness galls; and the recalcitrance is really as physiological as a yawn, and expresses a need of the body or soul for freer movement or fresher air.

The man who boasts that he has spent ten hours a day in his office for twenty years, and has never required a holiday, is boasting of his own infirmities. He is nothing more than a St. Simeon Stylites on an office stool, and his mind is probably as stiff as his spine. To occupy one rut is eventually to become a "stick-in-the-mud"; and to stick in the mud is hardly wise, however auriferous the mud may be.

Man is something more than a machine; he is not intended for continuous labour, and no one form of work can possibly give full exercise to his innate multifarious activities. He requires rest, and he requires variety; and these requirements holidays should supply.

Let it be fully understood that variety is as important as rest, and that each is supplemental to the other, for rest is often the best variety, and variety is often the best rest.

An Idle Holiday.

It is a mistake to consider an idle holiday a sign of a weak and depraved mind. Often idleness is not only medicinal but also educational; and a certain type of mind — frequently a high type of mind—cannot thrive without liberty and relaxation. Wordsworth, who himself idled greatly, and whose life, in its freedom, was one long holiday, counselled :—

> "Up, up, my friend, and quit your books,
> Or surely you'll grow double. . . .
>
> "One impulse from a vernal wood
> Can teach you more of man,
> Of moral evil and of good,
> Than all the sages can."

And Robert Louis Stevenson, one of the great holiday-making workers of the world, wrote as follows in his famous essay on "Idleness": "Extreme *busyness*, whether at school or college, kirk or market, is a symptom of deficient vitality; and a faculty for idleness implies a catholic appetite and a strong sense of personal identity. There is a sort of dead-alive, hackneyed people about, who are scarcely conscious of living except in the exercise of some conventional occupation. Bring these fellows into the country, or set them aboard ship, and you will see how they pine for their desk or their study. They have no curiosity; they cannot give themselves over to random provocations; they do not take pleasure in the exercise of their faculties for its own sake; and unless Nature lays about them with a stick they will even stand still. It is no good speaking to such folk; they *cannot* be idle—their nature is not generous enough; and they pass those hours in a sort of coma which are not dedicated to furious moiling in the gold-mill. . . . Look at one of these industrious fellows for a moment, I beseech you. He sows hurry and reaps indigestion; he puts a vast deal of activity out to interest, and receives a large measure of nervous derangement in return. Either he absents himself entirely from all fellowship and lives a recluse in a garret, with carpet slippers and a leaden inkpot; or he comes among people swiftly and bitterly, in a

contraction of his whole nervous system, to discharge some temper before he returns to work. I do not care how much or how well he works, this fellow is an evil feature in other people's lives. They would be happier if he were dead."

This, of course, is rather overdrawn ; but the fact remains that work too severe, too monotonous, too one-sided, is good neither for the body nor for the soul, and that the best remedy for inevitable defects in the character of a man's work lies in wise holidays—*i.e.* in rest and change—in the rest of change, or in the change of rest.

Periodical rest and change are really a mental and physical necessity, if mind and body are to reach and maintain full efficiency. Life is based on such a principle. Without rest the automatic functions of the body could not continue. From birth to death we must alternate wakefulness and sleeping. Each organ must have its period of rest and its period of activity. Even the heart rests between each beat, to store up fresh energy for its next effort, and if it does not rest long enough it becomes exhausted, and it may be necessary to give medicines to prolong its brief holiday. Without change, again, there could be no energy ; energy is the result of molecular change, and molecular change is the result of varying environment—of heat and cold, of food and light, etc. All our conscious life, too, is dependent on change. Were there only one constant colour it would be no colour ; were there only one constant temperature we should be unconscious of it ; under these conditions we should have neither colour sense nor thermal sense.

In using, therefore, rest and change as therapeutic agents, we are working on Nature's plan with Nature's great tools. Wise indeed was the great Hebrew prophet who wrote, " And He rested on the seventh day from all His work."

There are, it is true, some men who seem to need no holidays. They are brimful of energy, and the energy runs in certain channels and never seeks to burst its banks. They are never tired ; they want no change. In such cases it will be found either that the man's work is of such a nature as to afford in itself sufficient variety for the exercise of his various faculties ; or that he has, to the detriment of his health of mind and body, dammed back his energies from various natural outlets. In the former case his work affords variety, and in variety he finds both self-realisation and rest. In the latter case sooner or later he will suffer

The Man who Needs no Holiday.

for his self-imposed limitations, unless he occasionally finds liberty in a holiday. He may seem to be living a full energetic life; but let him retire from business and, body and mind, he will all go to pieces. Have we not all seen such collapses?

Probably *every* man is the better for a holiday—the better in mind, if not the better in body. However variegated his work may be, it can hardly cover the whole field of human activities, and a complete change can always be found, and will both widen his conscious life and increase his energy for his ordinary duties.

The need, however, for a holiday, and the exact nature of the holiday required, will vary with the individual and with his work. Some kinds of work, as we have said, have holidays in themselves, and other kinds of work particularly require holidays. Briefly, it may be said that excessive work, worrying work, depressing work, and one-sided work specially require the compensation of holidays. Of course, the same work may be more or less excessive, worrying, depressing, one-sided according to the individual who works.

In a general way, excessive work requires a restful holiday; monotonous work requires some livelier and more varied form of activity; while depressing and worrying work requires some distraction, some bright and fascinating interest.

The Overworked Man.

A man who has been simply overworked, mind and body, ought to seek as complete rest as possible. He should not take a holiday in London and Paris and "do all the sights"; he should not even go bicycling or mountaineering; he should retire to some quiet village among the hills, or at the seaside, and spend the day in a hammock or on a deck-chair. He should keep early hours and have abundance of fresh air. To endeavour to regain strength by big meals or long walks will be a mistake, for neither the stomach nor the legs nor the nervous system will have energy enough for great or prolonged effort. For such a man a sea-voyage, which compels rest, will often be the best holiday. It is true that to many hard-working men an idle holiday may seem a boredom almost intolerable; but they should realise in the first place that it is better to be bored than broken; and in the second place that their boredom is due to their own deficiencies. The strenuous life is not necessarily the best life, and the American millionaire, "too old at forty," may have lost his own soul. The man who cannot enjoy his own quiet

thoughts, who cannot take pleasure in natural scenery, who is bored by a country ramble, is certainly not living aright, and it is high time he be forced to take a holiday.

When a man's work is not excessive but worrying and depressing, he will require frequent holidays; but his holidays should give him not so much rest as recreation. He will be all the better for a course of entertainments; and provided that his heart be in good condition, active and even violent exercise will do him good.

Worrying Work.

A man whose work is one-sided will also require frequent holidays, even though the necessity for them may not be so evident. Monotony will depress vitality and atrophy healthy function quite as surely as overwork; and though the man may be quite fit for his daily duties, yet he may become unfit for anything else. One-sidedness is especially characteristic of business, and the man *devoted* to business requires constant holidays and many avocations to keep mind and body in health. Not only will certain mental or bodily faculties atrophy from disuse, but the atrophy will hamper the healthy working of other correlated faculties. No one faculty can say to another faculty, "I have no need of thee," for all the faculties of mind and body are related and dependent, and true health consists in *wholth*—in wholeness of mind and body—in the exercise of faculties and the enjoyment of capacities in proportion to their several importance. Not unwise were the young business men who remarked, "We are engaged in commerce during the day, but in the evening we employ ourselves seriously." "Perpetual devotion to what a man calls his business," says Stevenson, "is only to be sustained by perpetual neglect of many other things. And it is not by any means certain that a man's business is the most important thing he has to do." Again, "Might not the student afford some Hebrew roots, and the business man some of his half-crowns, for a share of the idler's knowledge of life at large and the art of Living?"

Monotonous Work.

When a man who requires a holiday refuses to take it, and keeps his nose at the grindstone, what happens? He loses spring and elasticity; he loses interest and pleasure in his work; he becomes depressed or irritable; or perchance he just becomes a machine fit for certain routine duties, unfit for anything above or beyond them. When the work is very excessive or anxious, he may completely break down;

his memory fails, he suffers from headache ; his sleep is disturbed ; he worries about trifles ; he becomes lacking in decision and enterprise ; and his general health steadily deteriorates. Sometimes he has recourse to alcohol or drugs to spur his failing energies ; but the relief is only temporary, and the last state of that man is worse than the first.

In all cases, therefore, when a holiday seems required, a holiday should be taken with as little delay as possible, and it is one of the most important duties of the physician to discern when a holiday is needed, and to prescribe in what form it should be taken. To tell a man simply to take a holiday is to be guilty of "terminological inexactitude," for "holiday" may mean many things. Tell the man who has been sitting at his desk for five years to take a holiday, and as likely as not he will go and climb the Matterhorn, and permanently dilate his flabby heart. Tell the man in the country-town who has been overworking, and who has lost his appetite, to take a holiday, and he may go and have "a good time" in London, and return "a regular wreck." Tell the man depressed by dull work to take a holiday, and he may go and visit his pessimistic maiden aunt and return more melancholy than ever. Indeed, the prescription of a holiday requires sound judgment and a knowledge of human nature ; while successful holiday-making is a fine art.

Short Holidays.

The ordinary day holiday of the masses is profitable chiefly to the publican and the railway companies. The holiday-maker departs at an unearthly hour in the morning, wedged in a railway carriage. The holiday brings him no refreshment, either bodily or mentally, and he wakens next morning tired and out of temper. Nor is the week-end or the week's holiday much better. Such a holiday is often ill-chosen and ill-used ; it is often overcrowded with excitements ; and the holiday-maker returns home in an exhausted condition.

In this connection reference may be made to the popular superstition that overwork of mind requires as a remedy overwork of body. Nothing could be a greater mistake. If the mind be *really* overworked, then the whole nervous system requires rest, and violent muscular exercise will merely produce general nervous debility. How many holiday-makers come back from their walking tours and mountaineering expeditions looking sunburnt and hardy, and yet really quite fagged out !

We do not mean to say that a man who has been using his mind all the year, and who has been leading a sedentary life, should avoid

all muscular exercise during his holiday ; we merely deprecate the customary excess of exercise. As a rule, and except in cases of severe overwork, muscular exercise in moderation is undoubtedly desirable. A holiday should be the balancing time of the year when the faculties which have been unused should receive their share of work, and when the faculties which have been too much used should be rested for a time. This is certainly the general principle on which a holiday should be planned, but it must not be forgotten that the nervous system is an indivisible whole, and that if it be exhausted by one form of activity, complete rest may be required. In fact, in many cases the best health resort is *bed.* Bed as a holiday resort is too much neglected, and few will retire there unless peremptorily ordered. Yet a holiday spent in bed is not necessarily such a penance. To lie at ease in a comfortable bed, at an open window with a view of hills or of the sea—to lie in bed with a pipe and an entertaining book, ought to be a luxury to a really tired man.

Holidays for those who have too much Play.

So far, we have dealt with holidays in their relationship to work, but they have also a relationship to play. It is quite possible to have too much variety ; it is quite possible to live a life too fast, too superficial, too fragmentary, and in such a case a holiday will be necessary. The Society butterfly, flitting about from ball to ball, from frivolity to frivolity, will suffer in soul and mind and body, and will require a holiday to restore her to health. The best holiday in such a case will be rest in bed for her body, and a little altruism for her mind. The rest in bed will restore her exhausted nervous system ; the altruism may cure her of *tædium vitæ* and discontent.

Besides their relationship to work and play, holidays have important relationships to disease, and in the treatment of disease play a very important part. For holidays imply not only change of occupation, but also change of air and change of food ; and all three changes are relevant to the treatment of disease.

We shall now consider special forms of holidaying, their advantages and disadvantages.

Walking is the most natural form of exercise, and a walking tour is, in most respects, an excellent way of spending a holiday. For those who lead a sedentary city life, a walking tour is especially suitable. " There is no time," says Stevenson, " when business habits are more

mitigated than on a walking tour." It is a mild form of exercise, and is unlikely to strain the heart, even if that organ be flabby. The movement of the limbs assists the lymphatic and the blood circulation, while the stimulus of a goal ahead, and the interest of changing scenery, make the walking more than a "dull mechanic exercise." The tour should be selected with reference to the particular interests of the tourists. Thus those who are interested in history should select a route through country rich in historical associations; those interested in architecture should visit castles and cathedrals; those interested in botany should find a district rich in flora. The recreative value of a holiday will be greatly increased if, besides muscular exercise and fresh air, it provide also intellectual occupation. In most cases the contour of the country should also be considered. Some people find flat land intolerably tedious; others are unable to face the fatigue of climbing. In hot weather it will be well so to regulate exercise that most of the walking is done in the cool of the day; and heavy knapsacks must be debarred. The tourists should take regular meals, and should always rest before and after partaking them. How many miles should be averaged a day, and the pace of walking, must depend on a variety of circumstances, but no attempt should be made to cover huge distances and to break records. Probably the ordinary man between twenty and fifty will find twenty miles a day sufficient. In most cases agreeable walking companions will increase the pleasure of the tour; but there are some who prefer to walk alone. "A walking tour," says Robert Louis Stevenson, "should be gone upon alone, because freedom is of the essence; because you should be able to stop and go on, and follow this way or that, as the freak takes you; and because you must have your own pace, and neither trot alongside a champion walker nor mince in time with a girl. And then you must be open to all impressions and let your thought take colour from what you see. You should be as a pipe for any wind to play upon."

Walking Tours.

There can be no doubt at all that a walking tour, rightly arranged, is one of the best sedatives and alteratives known. Let us quote Stevenson once more: "Everyone who has been upon a walking or a boating tour, living in the open air, with the body in constant exercise and the mind in fallow, knows true ease and quiet. The irritating action of the brain is set at rest; we think in a plain, unfeverish temper; little

things seem big enough, and great things no longer portentous ; and the world is smilingly accepted as it is . . . Our hearts will beat and our eyes will be bright as we leave the town behind us, and we shall feel once again (as we have felt so often before) that we are cutting ourselves loose for ever from our whole past life, with its sins and follies and circumscriptions, and go forward as a new creature into a new world."

Bicycling Tours.

A bicycling tour has many of the advantages of a walking tour, and it has the further advantage that much greater distances can be covered in a day. On the other hand, it has various dangers and disadvantages. There is a greater temptation to excessive exertion, and there is more dependence on wind, and weather, and roads. Nor is the attitude quite so healthy, since on a bicycle the arms are fixed, and there is a tendency to adopt a stooping posture. Still, a bicycle tour, unless the tourist does too much, is a most healthful form of holiday, and owing to the greater rapidity of motion and the quicker change of scene, it is more stimulating and exhilarating than a walking tour. It is well to see that the saddle is suitable and that the gear is not too high.

Motoring Tours.

A motoring tour is a way of holidaying so modern that its value has not yet been precisely estimated. One thing is certain—that its value varies greatly with the individual. Some people find it too exciting, and after some hours' motoring they cannot sleep. On other people it has just the opposite effect, for they find a few hours' motoring a cure for insomnia. To most people the rapid motion through the air is exhilarating, and in cases of depression motoring sometimes acts like magic. Anæmia and lack of appetite are also benefited by the rapid rush through the fresh air, and it has been proved by actual counting that motoring increases the number of the red blood cells. On the other hand, the dust which whirls round the car is bad both for the eyes and the lungs, and in some cases the vibration is bad for the nerves. It must be remembered, too, that motoring does not exercise the muscles and the heart, and that therefore a holiday spent entirely in motoring is apt to be very one-sided.

Riding Tours.

A riding tour, or a driving tour, is probably for most people a better form of tour than a motor tour. It is less exciting, yet equally exhilarating, and if the tour be taken on horseback the motion is as medicinal as it is delightful. Bacon said, some hundreds of years ago, that the outside of a horse is the best thing for

the inside of a man, and the great Lord Chancellor was not far wrong. A holiday on horseback is almost an ideal holiday, both for mind and body.

Boating Tours.

Boating tours are too rarely taken. The air of a river is pure, the scenery of a river is usually beautiful, and the exercise of rowing is one of the best kinds of exercise. The chief drawbacks to such tours are the "roughing it" necessary, and perhaps the tendency to overdo it. But for those who are not afraid to rough it, and who are not likely to hurt themselves by violent exercise, a boating tour is an admirable holiday.

Sea. Voyages.

A sea voyage is a big subject. A holiday at sea is usually a medical prescription for divers ailments, and its value varies both with the disease and with a variety of details too little regarded. A sea voyage is usually prescribed for overwork, for mental depression, and for consumption, and it is perhaps sometimes prescribed rather rashly by those not personally acquainted with the details of life at sea.

Let us consider first some of the general features of a sea voyage. The holiday-maker on an ocean-going steamer is suddenly completely divorced from his ordinary life. On Monday night he sleeps in a steady four-poster. On Tuesday he climbs over the wooden edge of his bunk, and is "rocked in the cradle of the deep." Perhaps it is very rough for days; perhaps he is a bad sailor, and in that case the next few days of his holiday are spent below in the stuffy atmosphere of his cabin. Having recovered from his bout of sea-sickness, he crawls up on deck, and finds groups of shivering, more or less green-looking fellow-mortals ensconced in deck-chairs. He is alone; he has no friend on board; he has not even the solace of a newspaper; and his holiday seems to be not exactly a success. Still, he lives through it, and perhaps the very next day the sun is shining warmly, and the air is like champagne, and there are flying-fish to be seen, or a green island, and so he cheers up, and develops high spirits and a huge appetite. Soon he makes friends, and the rest of the voyage may be unalloyed pleasure. There are no letters, no telegrams, no worries; there are hundreds of miles of blue water and surge between him and his old life, and so he lives without thought of the morrow, without much memory of the past, and kills time with cards and light novels and heavy meals. Occasionally the vessel may touch at a port; occasionally a storm may make

life more dramatic ; but as a rule existence is quite uneventful, save for meals and amusements.

Such is the average sea voyage, and even this brief picture will show that it is not to be rashly and indiscriminately prescribed.

For suitable cases, for persons run down by overwork or illness, but yet with physical or mental backbone, the prescription of a voyage usually answers excellently, and the voyager comes back ruddy and brown and robust. In cases, too, of anæmia and neurasthenia and mild depression, a voyage often works wonders. But in other cases a sea voyage will work nothing but harm. Patients on the verge of melancholia are not infrequently sent to sea to be cheered up, and not infrequently they jump overboard. Those who require nothing so much as rest and quiet are sent pleasure cruises round the Mediterranean, and are dragged round the sights of Naples or Palermo with a crowd of noisy, excited, uncongenial sightseers. Patients suffering from advanced consumption, too, are sent for a voyage. What does it mean ? It means that, ill, weak, depressed, they have to suffer such discomforts as we have already indicated. It means that they have to sleep in stuffy cabins, often with the porthole shut. It means that they can have no fresh milk and are restricted to ship food, which, however substantial, is rarely appetising. It means very often that they have to face the exhausting heat of the Red Sea or of the tropics. No one in the advanced stage of consumption should take his holidays in the form of a long sea voyage unless under very special conditions—unless, that is, he have a deck cabin, special diet, and a private attendant, and the voyage be only in temperate zones.

To send an alcoholic for a sea voyage holiday, that he may be out of temptation, is also ill advised. He will probably spend most of the day in the smoke-room, signing little cards that the smoke-room steward may bring him drinks. He will have nothing to do all day but drink, and he will vigorously do it. A long sea voyage is, in fact, about the worst holiday possible for an alcoholic. On the other hand, morphino-maniacs may well be sent to sea. At sea there are no chemists' shops, and the ship's surgeon will see that all his opium preparations are well locked up. Further, the bracing effect of the sea air will help to counteract the mental and physical depression caused by deprivation of the drug. In all cases, however, morphino-maniacs should be given specially into the charge of the ship's doctor, and they should not be sent without a companion.

Little details should not be neglected. A good cabin should be chosen ; it should be amidships, but should not be too near the pantries or the engine room. When possible, a deck-cabin should be procured, and if the ship has to come through a monsoon the lee side of the vessel should be selected. A good deck-chair and a good selection of books will add to the pleasure of the voyage.

The voyage prescribed, too, should be adapted to the requirements of the voyager. For one case a voyage with plenty of sight-seeing—a voyage, say, round the Mediterranean—may be desirable ; for another, a cruise round the Norway fiords ; for another, the monotony of a voyage round the world by the Cape of Good Hope and Cape Horn. In many cases a voyage through the Red Sea, especially in late summer and early autumn, must be interdicted. The voyage to the Cape is usually characterised by calm weather most of the way ; but for a few days in the tropics the heat is very exhausting. More bracing is a summer voyage across the North Atlantic to Canada, and this trip can often be prolonged with advantage to the top of Lake Superior. When the voyager is a bad sailor a large and steady boat should be chosen, and a little discretion in diet before sailing is always desirable.

Railway Tours.

Tours by railways over the Continent or across America should be undertaken only by the robust. The fatigue of railway travelling is always considerable, and in most cases it involves confinement in a stuffy atmosphere for many hours. Still, for those who are merely a little run down, and who require simply to be taken out of themselves, a railway tour may be beneficial, especially if taken in pleasant companionship.

Fishing and Shooting, Mountaineering.

A holiday spent in fishing and shooting is one of the best holidays possible. The only danger, in the case of shooting, is that of over-fatigue. Otherwise, such a holiday, with its combination of open-air life and mental interest, must be considered to be most healthful and stimulating. Mountaineering, in the strict sense of the term, is a form of holiday only for the very strong, who require and enjoy violent muscular effort ; it is not to be thought of in connection with anyone who is at all out of health.

CHAPTER XC

CLIMATE AND HOLIDAY

Bracing and Relaxing Climates—Temperature—Sunshine—Humidity—Purity of Air—Density of Air—Movements of the Air—Mountain Climates—Sea or Marine Climates—Desert Climates—Holidays for the Delicate.

CLIMATE is one of the most intrusive and important features of environment. We cannot evade it; it looks through our windows in the morning; it is mentioned in most salutations; and its effects on the health and spirit are known to all. "The term *climate*, in its broadest sense," says Humboldt, "implies all the changes in the atmosphere which sensibly affect one's physical condition"; and a change of climate or a change of air is one of the best and best-known of all remedies. When we consider the amount of air we breathe daily—when we consider that in the course of a year one breathes something like 100,000 cubic feet of air—when we consider, too, the intimate relationship between the skin and the atmosphere, we can understand how it is that slight chemical or mechanical variations in the atmosphere can affect the general health, and even be of advantage or disadvantage in particular diseases.

Whether a holiday be taken for health reasons or for pleasure, the question of climate should be always considered, and climatology has become quite a science. The robust man who has never known a day's illness may think that the fuss about climate is all a fad, but even he must admit that in some places he feels "fitter" than in others.

Bracing and Relaxing Climates.

Climates are roughly and popularly classified as "bracing" and "relaxing," and the adjectives quite aptly indicate the effect of the climates, so named, on the mind and body. In this country the east coast and the hills are usually bracing, while the west and the south are usually relaxing; but of course the character of the climate varies with the time of year, the direction of the wind, the altitude, and other circumstances.

When we examine what are the varying conditions of the atmosphere

which exercise such varied effects on the physical condition of human beings, we find that the composition of the air, its temperature, the amount of moisture it contains, its purity, its density, its movements, have each and all an influence on health.

One would think that the most variable feature of the air and the feature most relevant to health would be the chemical composition of the air. But as a matter of fact, the chemical composition of the outside air—and we cannot consider inside air as climatic—is remarkably constant. Hill air, sea air, town air, country air, have all approximately the same composition with respect to their essential gases—oxygen, nitrogen, and carbon dioxide; and any tendencies to variation are quickly corrected by diffusion and wind. Still, town air is sometimes rather deficient in oxygen, and probably a very small deficit has a considerable effect on vitality. Ozone is more plentiful in sea and hill air, and it is popularly thought to be of great importance to health, but though a good disinfectant agent it has little or no direct effect on the health.

Composition of the Air.

The temperature of the air notably affects the health of individuals and races. As a rule, the colder climates are the more bracing, and the inhabitants of colder countries have more energy and vigour. This is no doubt partly due to the fact that in hot climates the conditions of life are easier, and selection therefore—that is, the principle by which the fittest survive—is less stringent; but it is also due largely to the direct effects of cold on the physiological functions of the body. Most people feel much more energetic in cold weather, and inhabitants of temperate zones lose energy if they emigrate to tropical countries. A holiday involving much muscular exercise will be much more pleasant and healthful if taken in a cool country, or at a cool season of the year. Violent exercise in hot weather is always more or less exhausting.

Temperature.

As everyone knows, the appetite in cold weather is usually much keener than in cold.

For those in good health a climate with a certain amount of variation in temperature is best. Changes from hot to cold, from cold to hot, are stimulating to the constitution, and those who are compelled to live in a climate too equable are apt to deteriorate in health. Those, for instance, who winter in Madeira or Teneriffe often lose energy towards the close of their sojourn, and feel the need for the stimulus of

cold. The weak and the aged, however, who require to "husband out life's taper to the close," will live longer in a bland and equable climate. Certain cases of lung trouble, such as chronic bronchitis, will also be benefited by equability of temperature.

The idea is very prevalent that changes of temperature cause colds, and so well-known an authority on climates as Dr. Burney Yeo, in his work on "Mineral Springs and Climates," suggests that the equability of the temperature at sea accounts for the freedom from colds enjoyed by most people on sea voyages. But in these days of swift-going liners there may be great variations in temperature within twenty-four hours, and freedom from colds at sea is due chiefly to freedom from germs, while the colds people catch so frequently when they return to shore are due to the dust and germs of the land. In the Arctic Circle, where at certain seasons of the year there are violent changes from heat to cold, colds are almost unknown.

Sunshine.

The question of temperature is, of course, closely involved with the question of sunshine. It is the sun which warms the air, and it must not be forgotten that besides warming the air the sun exercises a vitalising effect both on the mind and on the body. Arctic explorers become melancholy and weak during the long Arctic winter, and rapidly recover strength and spirits when the sun reappears. All important health and holiday resorts keep and publish a record of the sunshine enjoyed.

Humidity.

Most people have a horror of a damp climate, and a damp climate is undoubtedly relaxing and depressing. The chief reason why damp is so unpleasant and so deleterious is that it interferes with evaporation from the skin, and thus both diminishes the elimination, by the skin, of waste material and renders extremes of heat and cold more trying. It is well known that damp heat and cold are much harder to endure than dry heat and cold. When the air is both damp and hot, evaporation from the skin, which is the most important means of cooling the surface of the body, is checked, and so the heat is much more oppressive. Again, when the air is both damp and cold it is a good conductor of heat, and conducts heat away from the body, and so the cold is much more trying. Damp air also does not penetrate so freely to the lungs, and this renders respiration much less efficient. Consumptives who have found it quite easy to breathe the dry air of the African karoo sometimes become very short of breath

when they return to damper climates. For these and other reasons damp climates are always depressing and relaxing.

Yet a damp climate is by no means so deadly as many people imagine, and much of the ill-health attributed to damp is really due to confinement to the house with shut windows. People go for a holiday to a rainy district, to the English Lakes, for instance, or Wales, or Devonshire, or the west of Scotland, and if it begins to rain they at once retire indoors and spend the day, or several days, in little rooms with the windows shut. Naturally they lose appetite and become listless and languid, and come to the conclusion that it is an unhealthy and relaxing district. Whereas if they had gone out in all weathers the holiday might have done them a world of good. No one who is afraid to face a shower of rain deserves a holiday. Nevertheless, those subject to rheumatism or bronchitis will be wise to choose a dry district for the holiday.

It is customary to consider a rainy climate a damp climate; and in one sense, of course, a rainy climate *is* a damp climate. But damp as a factor affecting health is not to be measured by rainfall. Madeira has a small rainfall, and yet it has a damp, relaxing climate; while there are other places which are really dry, but which have a heavy rainfall because they are visited frequently by rainclouds. It must be remembered that warm air can hold much more moisture than cold air, and therefore may be really much more humid, even though there is no rain. It may be noted, too, that other things being equal, a moist climate is usually more equable, with less sudden changes of temperature, than a dry climate.

Purity of Air.

Air contaminated with impurities, with irritating chemical substances, is certainly unhealthy; but such contamination, as a rule, is only local or temporary, and cannot be considered a climatic character. On the other hand, sea air and country air are always much freer from germs than is town air, and so all diseases due to microbes are much rarer at sea and in the country than in towns. It has been calculated that in Manchester a man breathes in ten hours 3,700,000 spores, whereas in mid-sea and on mountain-tops spores are almost absent. It was noteworthy in the Boer War how well wounds healed in the pure air of the veldt, and how little tendency there was to suppuration.

The density of the air or the weight of the air may seem to have

little relevance to health, but nevertheless it is a factor of considerable importance. By increasing and decreasing atmospheric pressure, marked physiological effects can be produced. Indeed, there is a well-marked disease known as caisson disease which is the result of continued work under extreme atmospheric pressure; while the well-known condition known as mountain sickness is caused chiefly by reduced atmospheric pressure. And even less extreme variations are not without effects on the functions of the body, and can be used for therapeutic purposes. The benefit derived from a sojourn in a high mountain health resort is largely due to the mechanico-physiological effects of reduced air pressure.

Density of Air.

Wind is of the greatest importance in maintaining a constant composition of the air. It causes a circulation of the chemical constituents of the air, and a consequent dissipation of impurities. The cooling effect of wind is well known. Cold which may be quite comfortably endured when the air is still, becomes intolerable when a wind blows. On the other hand, on a hot, sultry summer day a breeze is delightfully refreshing. Wind is usually bad for those who suffer from chest complaints, partly because it has usually dust in suspension, and partly because it encourages an indoor life. In Africa dust-storms are particularly pernicious, and winds blowing westward from the coast of Africa may carry fine, irritating dust even to the Canary Islands. There can be no doubt at all that typhoid, consumption, and some other diseases are sometimes carried by dust, and that the foul dust of cities is often the cause of chronic sore throats. In choosing a holiday, therefore, the question of wind and dust should be considered not only from the point of view of comfort, but also from the point of view of health. Indeed, the value of most of the high Alpine stations as winter resorts depends on freedom from wind, quite as much as an abundance of sunshine.

Movements of the Air.

One wind is rather maligned. Very few people in this country have a good word to say for the east wind, and most people regard it as equally dangerous and disagreeable. Yet, after all, the east wind is merely a dry, cold wind, which has no particularly pernicious influence of any kind on those who enjoy anything like good health. Indeed, the greater vigour of the inhabitants of the east coast as compared with the inhabitants of the west coast is due largely to the stimulating and bracing quality of the east wind. Even in winter the east coast

is not to be avoided ; it has a dry and sunny winter climate, while in summer a holiday spent on the east coast will be much more invigorating than a holiday spent on the south or the west coast.

We have discussed the chief atmospheric qualities that go to the making of climate : we will now briefly discuss mountain and sea climates, and desert climates, which have each their own special characteristics, with reference to these qualities.

Mountain Climates.

By mountain climates we mean climates which owe their chief characteristics to their height above sea-level, and to the proximity of mountain peaks of considerable height. This is rather a broad and vague definition, but still most climates so defined will be found to have their main features in common, though such health resorts as are above the ordinary cloud-level will differ in important ways from those below cloud-level.

We will deal first with mountain climates below cloud-level. Mountain climates of this kind found in Europe at various health resorts at heights below 3,000 feet are always bracing. The temperature changes quickly, the nights are usually cold, and there is usually a considerable rainfall and a good deal of wind. The air is pure and free from germs, and more or less rarefied, according to the height of the health resort. Residence in such climates will be found to improve appetite and to increase mental and muscular activity. Cases of anæmia, too, will usually be much benefited. On the other hand, if the heart be weak or unsound it will be taxed by residence at too high an altitude, and for such cases, therefore, a health resort at a lower level should be chosen. We have said the rainfall is usually considerable, but this will vary with the prevailing wind, and, as we mentioned before, a heavy rainfall does not mean great humidity. Where the humidity is pronounced, as in Wales and the west of Scotland, the climate will lose its bracing qualities and become relaxing.

There are no mountain resorts in this country above ordinary cloud-level, and the best known climates of this type are probably the high Alpine resorts in Switzerland, such as Davos (5,200 ft.) and St. Moritz (6,000 ft.). The most marked effects of such climates depend on absence of cloud and rarefaction of the air. Owing to the more or less complete absence of cloud and the dryness of the air, the rays of the sun are very powerful and penetrating, and so long as the sun is above the horizon there is

almost uninterrupted sunshine. On the other hand, there are extreme variations in temperature, for as soon as the sun sets the temperature quickly falls, owing to the fact that there is no moisture in the air to prevent the radiation of heat. Under ordinary conditions, water vapour in the air and clouds act as a blanket over the earth at night; but here the earth—to keep the metaphor—sleeps without a blanket, and so soon loses its heat and grows cold. At Davos and St. Moritz the temperature in winter may be 120° F. in the sun, and yet at night fall to 30° F. below zero—a difference of 150° F. in twenty-hour hours! Of course, this is exceptional, but still the daily range of temperature is always large. It might be thought that the intense cold would be trying, but this is not the case. Even when the air is very cold it is also very dry, and it is therefore a very bad conductor of heat from the body, and further, in the high mountain stations most frequented the air is remarkably still.

The rarefaction of the air renders deep breathing necessary, and increases the work of the heart. It also seems to have a special effect in increasing the number of the red blood cells, and the amount of hæmoglobin or colouring matter in the blood. A. Jaquet and F. Suter kept rabbits in Davos, and found an increase both in the number of red corpuscles and in the hæmoglobin of the rabbits' blood; and they obtained almost the same results by keeping rabbits in chambers in which the atmospheric pressure was artificially reduced to the air pressure found at heights of over 3,300 ft. Similar results have been obtained when similar experiments have been made on dogs, and pigeons.

The air of high Alpine resorts is not only dry and rare, but also exceedingly pure, so that decomposition of dead organic matter is considerably retarded. In winter the high Alpine climates are especially delightful. Sir Hermann Weber, writing in the *British Journal of Tuberculosis*, sums up as follows the physiological effects on man of mountain climates: " (*a*) Deeper inspirations; (*b*) strengthening of the respiratory muscles; (*c*) strengthening of the heart and all the organs of circulation; (*d*) increased amount of air inhaled; (*e*) increased excretion of carbonic acid and water through the lungs; (*f*) increased afflux of blood to the lungs and integuments; (*g*) improved action of the skin; (*h*) augmentation of appetite and digestive power; (*i*) amelioration of sanguification (hæmoglobin and red corpuscles); (*k*) improvement of the nutrition

of all organs, especially the lungs ; (*l*) raising of the functions of the nervous system."

It will be seen that mountain climates are a strong and stimulating medicine ; but the medicine must be used with discretion. Those with weak hearts and with debilitated constitutions will be wise to avoid the greater heights, while those with sound hearts and a fair measure of constitutional vigour will find mountain climates the best of tonics. Persons suffering from overwork and nervous debility will often be benefited by a few weeks' holiday in an Alpine climate. Those also with a tendency to consumption cannot do better than spend their holidays in the high Alps. In all cases, however, care should be taken not to do too much, since the heart takes some time to adapt itself to the height, and since the stimulating effect of the dry, sunny air produces a feeling of strength which tempts to excesses.

A few people suffer from insomnia if they go too high, and those with too excitable nervous systems will do better in the lowlands.

The winter sports, such as skating, in the high Alps holiday resorts, Caux, Villars, Montana, Adelboden, Grindelwald, Davos, St. Moritz, are exercises of the most healthful description.

Sea or Marine Climates.

Sea or marine climates are moister and more equable than hill climates. They are naturally moister because of the evaporation from the sea, and more equable because the moisture in the air prevents too rapid radiation of heat, and because the sea, when once heated, keeps its heat better than the land. The evaporation from the sea, too, prevents the sea from becoming too hot. Accordingly, sea and marine climates do not, as a rule, have extremes of temperature, and the daily difference between maximum and minimum is usually not great.

These qualities render seaside resorts not so stimulating as high hill stations ; yet marine climates are rarely relaxing, because of the sea breezes and because of the rapid variations in atmospheric pressure which occur on the coast, and which exercise a stimulating influence.

The important properties of sea air are well summed up by Dr. Burney Yeo as follows : "1, excess of what has been known as 'ozone' ; 2, excess of aqueous vapour and consequently greater equability of temperature ; 3, great purity and absence of organic particles ; 4, maximum density and great but regular variations of barometric pressure."

A holiday at the seaside has many advantages: sea bathing, sailing, steamer excursions, sea fishing, all encourage the holiday-maker to live in the open air, and there are not the same temptations to excessive exercise as are found in mountain resorts. Those who live far inland will find a change to the seaside particularly stimulating, and scrofulous children are especially benefited by sea air. Persons with chest complaints, on the other hand, may find the constant wind trying, and will often thrive better in more sheltered localities.

Desert Climates.

The climate of the desert in some respects resembles the climate of high Alpine stations. It is dry and bracing, with a wide range between day and night temperatures. The air is pure and free from germs; but after February there is apt to be a hot and dust-laden wind. Between November and April the climate is almost perfect, every day "fine, clear, bright, and sunny." "Nowhere on land," says Dr. Burney Yeo, "is air so pure, as nowhere else is there such complete absence of decomposing matters in the soil." The relative humidity at Assouan is so low that dew never falls, and the annual rainfall is hardly measurable.

A voyage in a dahabeeah up the Nile makes a pleasant and healthful holiday; but there is a good deal of wind, which may be trying to invalids. Camping out in the desert often proves beneficial in cases of phthisis. The chief drawback to the desert climate is the rapid and great fall of temperature at sunset, but this, in most cases, has an invigorating effect, and can be obviated by suitable clothing.

Holidays for the Delicate.

The tendency nowadays, whether in search of health or of pleasure, is to seek bracing and invigorating climates. The idea that the delicate require to be kept in hothouses is almost obsolete. The days of respirators and mufflers and shut windows are now over. In a very interesting article in the *British Journal of Tuberculosis*, Sir T. Clifford Allbutt tells how in his childhood he used to be companion of his father's cousin, a delicate lady, and how she used to be cloaked and muffled and wear a close black respirator covered with folds of fine Highland woollen veiling. "Under this treatment no one ever recovered. Even the great lady whose case was a nine days' wonder in our circle—the lady for whom, as she would not leave her children for Madeira, her devoted husband declared Madeira should come to her, and built her a garden of glass and shut her up in it—even she died, too, just like ordinary people."

Now things are very different. In 1877 Sir Thomas Allbutt visited Davos, a little village over 5,000 ft. high in the Swiss hills, and saw there "cures" by the score—absolute cures, as it seemed; and by what a daring and adventurous life! "At the first *table d'hôte*, amid the company of jolly, sunburnt skaters and tobogganers, I asked, 'But where are the patients?' If one was beginning to forget the sad-eyed, fading recluses of the Georgian parlours, one had hardly escaped from the impressions of the fragile roses of the Riviera. Who, then, were these brown, untransparent men and women, vociferating about sports and emptying dishes almost before they reached the table?"

In consumption this has been the trend of treatment. And consumption has been an object-lesson; it has been recognised that what is good for a consumptive is good for most other people. Instead of sending the delicate to bland, enervating climates, they are sent to the high Alps. Instead of shutting the windows they are opened. Instead of giving the invalid jellies and beef-tea, he is given beef and bread and butter.

This is the general rule, but, of course, there are some exceptions. The aged, the debilitated and broken down must choose for their holidays warm, bland climates; and for certain diseases, cold and bracing climates are contra-indicated.

But climate is not everything in a holiday. Those who are to benefit from a climate must *make use* of it. We have seen the invalid sent for a sea voyage spend about fifteen hours a day in the smoking-room. We have seen the invalid sent to some Swiss health resort spend half the day in a stuffy hotel room playing bridge. After all, the outdoor climate of the most insalubrious part of England is healthier than the indoor climate of a Swiss hotel.

In the case of an invalid, not only air but also diet is of importance, and much of the reputation of foreign health resorts is due as much to change of food as to change of air. On the other hand, insufficient or unsuitable food may more than neutralise the beneficial effects of a very fine climate.

CHAPTER XCI

HEALTH AND HOLIDAY RESORTS AT HOME AND ABROAD

Seaside Resorts in England and Wales—Seaside Resorts in Scotland and Ireland—Continental Seaside Resorts—Madeira and the Canary Isles—Hill Resorts—Desert Resorts.

Having now discussed, in a general way, the question of holidays and climates, we will describe briefly some of the principal health and holiday resorts.

Seaside Resorts in England and Wales

These may roughly be classified as western, southern, and eastern, each having certain characteristic features. The southern and western are usually relaxing, the eastern usually bracing. So numerous are the seaside resorts of Britain that we can do little more than mention a few of the most important of them.

WALES

Tenby is one of the mildest, sunniest, and driest seaside resorts of Wales; it is situated on a peninsula on the south-west coast of Pembrokeshire. It is suitable for bronchitis and heart cases. There are magnificent sands, and good and safe bathing.

Aberystwith and *Barmouth* are both situated on the west coast of Wales. Both have mild, equable climates and good bathing, but Aberystwith has rather a large rainfall, 46 inches. The scenery round Barmouth is very fine.

Llandudno, situated on the north coast of Wales, has many attractions. It lies between two hilly elevations, Great Orme's Head and Little Orme's Head, and is sheltered from north-westerly winds. Though in Wales, it is outside the rainy area, and its rainfall is only about 31 inches. It is chiefly used as a summer resort, but even in winter it is sunny and dry. The bathing is good, and there are beautiful

drives in the neighbourhood. In midsummer it is rather relaxing, and is apt to be overcrowded with tourists and trippers.

WEST COAST OF ENGLAND

On the west of England in the north, on the Lancashire coast, are *Southport* and *Blackpool.* Both have climates rather drier and more bracing than are usually found in the west. In midsummer and autumn Blackpool is rather noisy and overcrowded, and should be avoided by those who wish peace and quietness. Southport rejoices in an art gallery, winter and botanic gardens, and a public park.

On the north-western coast of Cornwall and Devon we find the seaside resorts *Newquay*, *Westward Ho*, and *Ilfracombe.* These are all attractive, and each has its own special advantages. Newquay has a comparatively low rainfall, 33·5 inches, and an unusually large amount of winter sunshine. Fogs are almost unknown. Westward Ho has excellent golf links and its famous pebble ridge. Ilfracombe is in a part of England unrivalled perhaps for the beauty of its scenery, but even Ilfracombe is inferior in loveliness to Lynmouth and Lynton.

The *Scilly Islands,* situated forty-two miles off Land's End, are said to possess "the most equable temperature in the British Islands, if not in all Europe." On the other hand, they are very windy. At St. Mary's, Scilly, the mean temperature in the two coldest months of winter is 45·3° F.

SOUTH OF ENGLAND

The south of England is studded from east to west with well-known seaside resorts. The more westerly of these are the moister, warmer, and more relaxing; the more easterly are the colder and more bracing. But local conditions—*e.g.* protection from north and east winds—modify the climate in individual instances. We will describe a few of the best known from west to east.

Penzance is the most westerly seaside resort in England. Its climate is mild, equable, relaxing, wet, and windy. It is not a place where full muscular vigour can be cultivated, and even for the elderly and debilitated better places of the same type can be found.

Falmouth as a health resort has been growing in popularity. Like Penzance, it is mild and moist, but it has less wind. There are many interesting excursions around the town. The rainfall is 44 inches.

Torquay is probably the most popular and best known seaside resort

in Devon. It faces south-west, and is protected from north and north-west winds by a circle of hills. The climate is mild, equable, and humid, and the rainfall is 35 inches. Torquay is best known as a winter resort and is generally considered too relaxing for summer ; but it is really cooler in summer than some places farther east. The mild, moist climate is suitable for the old, and for some cases of chronic phthisis and bronchitis ; but, as a rule, phthisical patients require a more bracing climate. There are good bathing, boating, and sea-fishing for the holiday-maker, and the surrounding scenery is very picturesque.

Teignmouth is a seaside resort not far from Torquay, and resembling Torquay in its climate. The rainfall is 37 inches, and there are 180 wet days annually. The following meteorological facts are typical not only of Teignmouth but also of the whole stretch of adjacent coast :—

January

Mean temperature	41·8° F.
Humidity, 9 a.m.	88·0 per cent.
Mean total rain in inches	3·40 per cent.
Mean number of wet days	16·0

July

Mean temperature	61·8° F.
Humidity, 9 a.m.	76·0 per cent.
Mean total of rain in inches	2·33 per cent.
Mean number of wet days	13·0

Sidmouth is a seaside resort of the same type as Teignmouth and Torquay. It enjoys a large amount of *winter* sunshine.

Weymouth, in Dorsetshire, about midway between east and west, is also midway in climate. Less relaxing than the Devonshire and Cornwall seaside resorts, it is yet not so bracing as Brighton and Folkestone. It has special facilities for sea bathing, and is one of the best places on the south coast for boating. In winter, however, the east wind is rather trying.

Bournemouth, though farther east than Weymouth, has a milder climate, and is chiefly in repute as a winter resort. The rainfall is low, 27 inches, and the soil is sandy and permeable, so that it quickly dries. The town is sheltered from north, north-east, and east winds by low hills, and additional protection is afforded by pine-trees. The mean temperature of the two coldest winter months is 39·7°, and the mean

relative humidity of the same months is 87. Bathing is good, and there are many interesting walks.

Bournemouth has long been a favourite resort of consumptives, but a climate so mild, humid, and relaxing is not the best for the majority of consumptive patients. It is more suited for bronchitic cases.

The climate of the *Isle of Wight* varies, to some extent, with the locality; but as a whole it is moist, mild, and relaxing, and though it has many charming health resorts, it cannot be considered altogether a desirable place for most invalids. Ventnor has long been famous as a place for consumptives. It is sheltered from the north and north-east, and is partially sheltered from the north-west, west, and south-west winds. The rainfall and the mean relative humidity are about the same as those of Bournemouth, but the temperature in the coldest winter months is about 2° higher. The climate of Ventnor has been rather over-estimated, and though it is sunny and equable, it is too enervating to be suitable for consumptives. Other seaside resorts in the Isle of Wight, rather more bracing than Ventnor, are Ryde, Cowes, and Sandown. Cowes and Ryde are both great centres of boating and yachting.

Brighton, on the coast of Sussex, has long been famous for its bright, breezy, and bracing climate. The mean annual rainfall is 30·4 inches, and the relative humidity 78. The chief drawback to Brighton is the size of the town, which renders the air less pure when the wind blows from the land. Southerly and westerly winds, however, are always pure and bracing. According to Dr. Burney Yeo,* "Brighton is especially serviceable in cases of retarded convalescence, especially after surgical operations and also after some acute febrile maladies. It is useful in cases of anæmia and general loss of tone induced by overwork, by chronic illnesses, or by other depressing agencies. It is of value in giving vigour to delicate young people, especially when of scrofulous constitution, during the most trying periods of rapid growth and development. Its bracing sea air and sea baths are also beneficial in diminishing that sensitiveness of skin and mucous membranes upon which the prevalent tendencies to catarrhal and rheumatic tendencies depend."

Eastbourne, also on the Sussex coast, has a climate like Brighton, but is rather less windy and bracing, and its relative humidity is higher.

* "The Therapeutics of Mineral Springs and Climates," by I. Burney Yeo, M.D., F.R.C.P. (Casseli & Co., Ltd.)

It possesses good golf-links and an extensive sandy beach; while behind the town there are magnificent downs.

Hastings with *St. Leonards* is the third great seaside resort on the Sussex coast. In all essentials its climate resembles the climate of Brighton and Eastbourne. It is protected to the north and north-east by high cliffs. There are two piers, and an esplanade with numerous shelters.

Folkestone is one of the most attractive of English seaside resorts. Its rainfall is only 25 inches, and it enjoys abundant sunshine. The principal promenade, however, is very high and exposed, and is perhaps rather windy for invalids. It is free from trippers and from the noisier amusements of seaside resorts.

THE EAST COAST

The special features of the eastern seaside resorts have already been mentioned. They are drier, colder, and more bracing than the seaside resorts of the south and west.

Margate has long been famous as a health and holiday resort, and Margate air has a special repute in the case of scrofulous children. Its average rainfall is only 23 inches, and its mean relative humidity 82. Having a north and north-east aspect, Margate is exposed to winds from these quarters which at certain seasons may be rather trying. It has very extensive sands. At certain times it is very noisy and overcrowded. The best quarter of the town is known as Cliftonville.

Ramsgate has a climate somewhat like Margate, but is more sheltered from the north and east.

Cromer, on the north-east coast of Norfolk, has a bracing, sunny climate, and is one of the driest and healthiest places in England. There are extensive sands and a very fine golf-links. In summer it is never too hot, and is much to be preferred as a health resort to the more relaxing seaside resorts in the south and south-west. In 1902 the rainfall for the second half of the year was only 9·5 inches, and of these 2·9 inches fell in August, the wettest month of the year.

Sheringham and *Mundesley*, both within a few miles of Cromer, share its bracing climate, and each has a golf-links. Sheringham golf-links is one of the best in England.

Whitby and *Scarborough*, on the Yorkshire coast, have dry and bracing climates, good bathing, and good sea-fishing.

Seaside Resorts in Scotland and Ireland

The seaside resorts of Scotland and Ireland are fewer and less popular than those of England.

On the west of Scotland are *Rothesay* and the *Isle of Arran*, both of which have typical western marine climates—equable, mild, and moist. There are good bathing and very fine scenery. In the summer months Rothesay is at times rather overrun with Glasgow trippers.

On the east of Scotland are *North Berwick*, *St. Andrews*, *Stonehaven*, and *Nairn*. North Berwick, at the mouth of the Firth of Forth, St. Andrews on the coast of Fifeshire, and Stonehaven on the coast of Kincardineshire, have the ordinary climatic characters of the east coast of Scotland; they are cold and windy and bracing and dry, and are better as summer than as winter resorts. Nairn, on the other hand, though farther north, on the coast of Nairnshire, has a mild climate and a low rainfall, and is chiefly to be recommended as a winter resort. In winter there is little snowfall, hard frost is exceptional, and mist and fog are almost unknown. The rainfall is only a little over 20 inches, and the mean annual temperature is about 46°. There is an excellent golf-course, picturesquely situated.

In Ireland well-known and much-frequented seaside resorts are more rare even than in Scotland. The south and south-west of the coast of Ireland are too wet and too relaxing to be suitable for invalids, but those who are not concerned about their health and who seek fine scenery may find on the south-west coast scenery both beautiful and romantic. In the north-west there is the seaside resort of *Bundoran*, which has a fairly bracing climate with wild and magnificent scenery.

In the north there is *Portrush*, the "Brighton" of Ireland, which has a bracing, windy climate, though a large rainfall. It has a golf-course and good sands. On the east there are *Rostrevor*, *Newcastle*, *Kingston*, and *Bray*, all with mild and dry climates and beautiful scenery.

In the English Channel, between France and England, are the *Channel Islands*, with a moist, equable, relaxing climate, and with beautiful scenery. "The climate is said to favour growth in the young and promote longevity in the aged; to be useful for scrofulous children, for cases of torpid phthisis in adults, and for aged persons with bronchial catarrh, who find themselves more comfortable in a mild moist climate than in a dry one."

Continental Seaside Resorts

The Continental seaside resorts most frequented by the English, are those on the north coast of France, those on the Riviera, and Biarritz, on the south-west coast of France.

On the north coast of France are *Boulogne*, *Dieppe*, *Trouville*, and *St. Malo*. These have climates resembling the seaside resorts on the English side of the Channel, but they offer, to those who require mental distraction, a more complete change of environment than can be obtained in England. The bathing is good and the Casinos—especially the Casino of Trouville—very fine.

We cannot here discuss the *Riviera* in detail, and will only touch on a few of its leading features. For many years it has been a winter and spring resort for multitudes of health and pleasure seekers. It is essentially a land of sunshine and of wind. It is also a land of heavy rainfalls and few rainy days. At Nice during winter there are about eight times as many clear sunny days as London enjoys. At Nice, again, between October and April, there are only thirty rainy days, while in London during the same period there are seventy-six. Yet the rainfall at Nice is almost twice the rainfall at London.

The *mean* winter and spring temperature of the Riviera (between October and May) is from 8° to 10° higher than that of England. The chief drawbacks to the climate of the Riviera are windiness and rapid changes of temperature. The air is scarcely ever still, although, of course, some localities are much more protected from prevailing winds than others.

All things together, the Riviera though a beautiful, cannot be considered a perfect climate. It is relaxing and changeable and windy, and it is to be recommended rather to the pleasure seeker who wishes simply beautiful scenery and sun than to the invalid who needs either a bracing or an equable climate, and in most cases it is a mistake to send consumptives there. The most frequented spots on the Riviera are *Hyères*, *Cannes*, *Nice*, *Mentone*, *Monte Carlo*, *Bordighera*, and *San Remo*. Each of these has little climatic idiosyncrasies which we need not here discuss, but it will be interesting to compare their climates in a general way with the climate of some of the seaside resorts in the south of England. Mr. Kitto, in "Cornwall as a Winter Resort," draws the comparison in the following table, compiled from various sources:—

	Latitude	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*March*	*April*
Falmouth .	50° 9′	47·5	44·4	43·2	43·5	43·9	47·4
Penzance. .	50° 7′	46·8	43·5	42·2	42·8	43·6	48·4
Scilly . .	49° 55′	49·9	47·1	46·0	46·0	45·8	48·7
Mentone . .	43° 45′	54·0	49·1	48·7	49·1	52·8	58·3
Nice . .	43° 41′	52·0	46·9	45·4	46·5	50·9	57·1
Cannes . .	43° 32′	52·6	46·3	48·0	48·8	51·0	55·6
Pau . . .	44° 19′	47·0	42·8	41·2	43·6	48·8	51·8

Biarritz, on the Bay of Biscay, has a wet and windy and yet bracing climate. It has very picturesque scenery and magnificent sands. Its winter season lasts from November to the end of March.

Malaga, *Sicily*, and *Sardinia* may also be mentioned as popular marine resorts.

Madeira and the Canary Isles

Madeira has been a health resort for generations, but of late years has rather fallen in repute. Its climate is warm, moist, sedative, and equable, but it is not calculated to promote bodily vigour, and is quite unsuited for most consumptive patients. For those, however, who wish merely to avoid the rigours of the English winter, it is a charming resort. The mean daily temperature is 61° F. in winter and 71° F. in summer. The scenery is beautiful.

The *Canary Islands*, on the whole, are warmer and drier than Madeira, but the climate varies considerably with the island and with the part of the island. The islands most visited are *Teneriffe* and *Grand Canary*. *Orotava* is the most frequented resort, but the heat there is rather moist and relaxing ; and *Guimar*, on the other side of the island, is drier and more bracing. Orotava has been described as " an enervating Eden, a climate which diffuses over one a deliciously dreamy languor." The scenery of the Canaries is both beautiful and grand, but there is a lack of roads, and amusements are limited. The rainfall in many parts is very small.

West Indies and the South Sea Islands

The *West Indies* and *South Sea Islands* are also popular resorts for health and pleasure, and there are many other islands and seaside resorts famous for climate or scenery with which we have not space here to deal.

Hill Resorts

The hill resorts of Great Britain are much less numerous than the seaside resorts ; indeed, there are very few hill resorts in Great Britain, and none of great importance. In England we have Buxton (1,000 feet) and Harrogate (600 feet), but these places owe their popularity not so much to their altitude as to their mineral springs and waters. Llandrindod (700 feet), in Wales, also owes its popularity to its mineral waters and baths. Perhaps the only hill station, pure and simple, in Britain is Braemar. Braemar is situated at a height of 1,100 feet in the Grampian hills, and amid some of the finest scenery in Britain. Its climate in summer is bracing and exhilarating. Its height, too, is sufficient to produce some of the physiological effects of reduced air pressure. On the other hand, its winter climate is harsh and inclement, and its tourist season necessarily brief.

Britain, having few hill stations of its own, depends, like many other European countries, on the hill resorts of Switzerland, which are famous all the world over. We will now briefly discuss a few of these.

Davos is a village situated in a mountain valley in eastern Switzerland. It is over 5,000 feet above sea-level, and is therefore considerably above average cloud-level, and with the climatic characters consequent on such elevation. On either side of the valley of Davos the hills rise to a height of 9,000 or 10,000 feet, and the village is thus well protected from wind. Davos has both a winter and a summer season, but the winter season attracts most visitors. It can be reached from London in less than twenty-four hours, and there are numerous hotels and pensions.

The climate of Davos has the following characteristics :—

1. The air is much rarefied ; the mean barometric pressure being decidedly low.

2. The average temperature, too, is low, the annual mean being 37° F. From about the middle of November to the middle of April the ground is covered with some feet of snow, and the temperature averages between 20° and 30° F., and frequently falls to below zero.

3. The air is very dry, and contains only a small amount of aqueous vapour.

4. The sky is usually cloudless and blue, and solar radiation very intense. In an average winter there are 102 fine days, 22 medium, and 58 bad ; and January has 55 per cent. of possible sunshine.

5. The air is free from organic impurities, and in winter also quite free from dust.

6. There is almost no wind, and in winter the atmosphere is almost always still.

7. The air has a high content of radio-active substance and of electric potential.

8. The difference between shade temperature and sun temperature is very great, and as soon as the sun sets a fall of 50° or 60° F. in winter is quite common. We have already pointed out the striking differences that sometimes occur between day and night temperatures both at Davos and at St. Moritz.

Owing to the dryness and stillness of the air, the cold of winter is little felt, and it is quite common for visitors to skate in thin summer garments.

Davos is essentially a health resort, and is probably the foremost health resort for consumptives in the world ; but it is also a great sporting centre, and has the largest ice rink in Switzerland, good ski-ing slopes, a special bob-sleigh run, and several good toboggan runs. Owing to the number of invalids it proves depressing to some, but it should be clearly understood that there is no risk of infection.

St. Moritz, separated by a range of hills from Davos, rivals it as a health resort and as a sporting centre. In most respects its climate resembles the climate of Davos, but it is about 800 feet higher, and is rather windier in winter. It has both a winter and a summer season. Most of the St. Moritz hotels advertise that consumptives are not received, and as a rule only a few early cases winter there. Those who are run down with overwork, or convalescent after illness, or neurasthenic, will find St. Moritz air very stimulating and tonic ; but cases suffering from insomnia may find the air too exciting. St. Moritz has the most famous ice toboggan in the world, and several skating rinks. It has, moreover, good iron springs.

Leysin is the principal mountain health resort of western Switzerland. It is situated in the Vaudois Alps on a plateau 4,780 feet high, protected from the north and north-east by pine-clad mountains, but quite open to the south. The climate in many respects resembles the climate of Davos; it is dry, sunny, and still. But the mean winter temperature of Leysin is about 10° higher than the mean winter temperature of Davos, and there is more sun. Leysin, however, is almost entirely

given up to the treatment of consumption, and is therefore not attractive to the healthy tourist.

Montana, situated not far from Leysin and on the same side of the Rhone valley, has recently, under the auspices of Dr. Lunn, come into prominence as a winter sports centre. Like Leysin, it lies on a plateau open to the south and sheltered from the north, and it is about the same height above sea-level. Dr. Burney Yeo thinks it "better suited for a quiet, moderately bracing summer retreat than a winter residence"; but in summer it lies in the full blaze of the sun, and is too hot for most people.

Caux, situated on a small plateau about 3,300 feet above Montreux on Lake Geneva, is another mountain resort, with a winter as well as a summer season. As a winter resort it lies rather low, for it is not unfrequently bathed in the mist which rises from the lake. Further, there is often a deficiency of snow, and there are occasional thaws. Caux has two large comfortable hotels and a skating rink; while the road down to Montreux makes a good toboggan run. The place is free from invalids, as the hotels will not take consumptives. In summer Caux is very popular, and is thronged with tourists.

Les Avants is situated at a lesser elevation, a few miles from Caux. It has both a summer and a winter season. In winter it is frequented by many consumptives. Like Caux, it suffers from mists which rise from the lake. There are a skating rink and toboggan runs. The spring flowers at Les Avants are especially beautiful.

Adelboden is one of the most popular of the winter resorts in Switzerland. It is situated at a height of 4,660 feet in the Bernese Oberland. It has a sunny climate, free from mist, but is rather subject to wind. There are several skating rinks and toboggan runs, and many slopes suitable for ski-ing. Adelboden is also a much frequented summer resort, and is a good centre for excursions. The hotels, it may be mentioned, decline to take cases of tuberculosis.

Villars-sur-Ollon (4,166 feet) is situated on a plateau above Aigle, and is one of the most beautiful and desirable of Alpine summer and winter resorts. There are a large skating rink and good tobogganing and ski-ing.

Château d'Œx (3,498 feet), also above the Rhone valley, is a popular winter and summer resort.

Grindelwald, in the Bernese Oberland, has long been famous as a

centre for mountaineering and for winter sports. It has some of the best-kept ice-rinks in Switzerland, but in midwinter has little sun.

The mountain resorts we have mentioned are chiefly winter stations, but there are many other mountain resorts in Switzerland more suitable as summer resorts. To describe all these in detail would be impossible here, and we shall merely mention the names of a few of them —Riffelberg, Riffel-Alp, Bel-Alp, the Rigi, Mürren, Zermatt, Evolena, St. Beatanberg, Engelberg, Pontresina, Maloja.

In the Austrian Tyrol are Innsbruck and Meran.

Some mountain resorts in North and South America very much resemble the Alpine stations we have mentioned. In South America, in Peru near Lima, are the mountain towns Turma, Jauja, and Huancayo. At Huancayo (or at Jauja, which is cooler) the sky is never other than sunny, or the atmosphere pure and bracing, and the temperature is very equable, the annual range not exceeding 10° or 12° F. Quito, in Ecuador, at a height of over 8,000 feet, and Santa Fé de Bogota, in the United States of Colombia, have also superb Alpine climates.

In North America, in the United States, are the well-known mountain cities, Denver (5,280 feet) and Colorado Springs (6,000 feet). Other less known resorts in the United States are Cañon City, Glenwood, Estes Park, and Manitou Park. In Canada, in the Rocky Mountains, are Banff and Glacier House. There is said to be more sunshine in winter at Denver and Colorado Springs than at Davos or St. Moritz. Colorado Springs, however, occasionally has disagreeable dust-storms, accompanied by an electric and trying state of the atmosphere.

Desert Resorts

Desert resorts are necessarily few. The best known are Helouan les Bains, Luxor, and Assouan.

Helouan les Bains is built on a desert plateau, 16 miles south of Cairo. It has several good hotels and a golf-course. Its relative humidity in winter varies from 30 to 60 per cent., and there are on the average nearly eight hours' sunshine daily. Helouan has sulphur baths and a well-equipped bathing establishment.

Luxor is 450 miles south of Cairo. It is warm and sunny, and almost rainless. After the middle of March, however, it becomes uncomfortably hot. Close to Luxor are some of the most interesting monuments of Egypt.

Assouan is 580 miles south of Cairo, near the first cataract. It is even warmer and drier than Luxor, and its mean minimum winter temperature is 6° or 7° F. higher than at Cairo. "Assouan," says Dr. Burney Yeo, "has all the characters of the Egyptian climate in a very marked degree, viz. warmth, dryness, almost uninterrupted sunshine, and purity of air from the desert."

Biskra, on the south side of the Lesser Atlas Mountains, has also a desert climate, dry and sunny, but its salubrity is marred by windstorms which raise clouds of dust. The rainfall is only about 6½ inches.

CHAPTER XCII

THE RATIONALE OF EXERCISE

Exercise a Necessity—Growing Need for Artificial Exercise—Amount of Force Expended by the Body—The Three Ways in which it is Expended (1) Body Heat, (2) Internal Work, (3) Muscular Energy—When Exercise is Necessary—Athletic Pursuits Insufficient—Reserve of Strength—What Getting Fat Means—A Good Physique—Physical Fitness—Exercise Defined—Choice of Exercise—Principles of Exercise—Monstrous Biceps—Where Strength should be Developed—Advantages of Exercising the Lower Limbs—Sound Feet.

Exercise a Necessity.

THE expenditure of physical energy is a necessity for human well-being. The exercise may be natural—that is, part and parcel of one's daily work; or it has to be artificial—that is, an expenditure of muscular force superadded to the ordinary daily employment.

When muscular expenditure does not constitute the main part of one's life's work, as it does in the case of the labourer, the carpenter, the blacksmith, and those engaged in similar pursuits, it is necessary to take exercise in some form to prevent deterioration of health. The principles of this belief have been acted upon by mankind in the past, and will continue as a necessity for individual, national, and racial welfare for all time.

In earlier periods of human existence, when tilling the soil or following the chase constituted the sole occupations of men, the recognition of the expenditure of muscular force as a physiological entity or as a hygienic duty was unnecessary, and therefore did not require consideration; but as people multiplied and drew together into communities, villages, and towns, sections of the people took up special duties of a less natural type, necessitating a minimum of muscular expenditure.

In Britain, as in almost all civilised countries, the number of people engaged upon indoor employments has multiplied enormously during

the past fifty years. In fact, ever since steam came into general use, and machinery took the place of hand labour in manufactures, with all the attendant factories and commercial houses, the problem of artificial exercise has become a vital one in national economics. The whole question may be reduced to this: How are persons engaged in indoor employments and dwelling in cities to obtain a sufficiency of exercise to keep them healthy? The subjects of housing, food, drink, and general hygiene are dealt with elsewhere in this work, so that it is merely the expenditure of muscular energy or exercise as a part of general hygiene which this and the following chapter deal with.

Growing Need for Artificial Exercise.

The channels by which the energies of the human body are expended are (1) heat, (2) internal work, (3) muscular force.

The force expended daily by the human body has been calculated with almost mathematical precision. The total amount of this force is 3,400 foot-tons. To understand the meaning of this statement it is necessary to explain "foot-tons" and "foot-pounds." The force required to raise a 1-pound weight 1 foot from the ground is technically termed a foot-pound; and likewise the force expended in raising 1 ton 1 foot off the ground is termed a foot-ton. The foot-pound is the work-unit upon which all calculations of expenditure of energy are made. Of the total 3,400 foot-tons of energy expended daily by a healthy man weighing 11 stones (154 pounds) engaged upon work requiring an average amount of muscular force—say the ordinary day's work of a farm labourer, a force equivalent to 2,840 foot-tons of energy is devoted to the maintenance of body heat in a temperate climate. By the functional work of the organs of the body 260 foot-tons of energy is expended, leaving but 300 foot-tons of energy to be spent in muscular energy.

Amount of Force Expended by the Body.

Let us now consider, in turn, the three channels by which the energy of the body is expended, beginning with heat.

The fact that of 3,400 foot-tons of energy expended in twenty-four hours no fewer than 2,840 foot-tons are concerned with the maintenance and regulation of the temperature of the body shows the overwhelming importance of the factor of heat in the economy. The generation of heat in our bodies is brought about by every muscular contraction, by the movement of joints, by the chemical changes within the alimentary canal, the organs of the body and the

1. Body Heat.

blood ; and, by the functional activity of the brain, the organs of secretion, absorption, and excretion. The estimation of the amount of heat generated is based upon what are termed "units of heat," and the conversion of units of heat into work-units, or foot-pounds of energy, is determined upon the following calculation, which the reader may disregard if he please. To raise the temperature of a given quantity of water 1° F. is found to equal the force expended in raising $\frac{1}{3}$ foot-ton, or about $746\frac{2}{3}$ pounds, 1 foot from the ground. The normal temperature of the body is 98·4° F., and to produce this amount of heat 32·8 foot-tons of energy would suffice. But to maintain this temperature, owing to the rapid loss of heat the body is constantly undergoing, requires a force 86 times greater ; in other words, a force equivalent to 2,840 foot-tons of energy.

Heat is lost to the body by radiation from the skin, by the heat in the air expelled from the lungs during breathing, and by way of the excretions from the kidneys and the intestines. The skin is the chief channel by way of which heat leaves the body, and the only one of the several eliminating channels which it is possible to control. Insufficient clothing will allow of an excessive loss of heat, necessitating a larger quantity of food being taken to maintain a normal standard. For if the standard is not maintained the bodily energies expended in other directions are called upon to supply the deficiency, to their detriment, and especially to the detriment of muscular energy.

Average Amount of Clothing.

The average amount of clothing required in a temperate climate, such as that of England, is 1 pound of clothing to every stone weight of the body. Thus a child weighing 3 stones requires 3 pounds of clothing, and an adult weighing 11 stones requires 11 pounds. The weight of the clothing is the only standpoint from which any rule can be deduced, for the relationship of the texture of the clothing to the body heat is not capable of being stated in any terms approximating precision.

We shall see later how this rule is transgressed, and the effects of such transgression on the physique. It is to be understood, of course, that the weight of the clothing varies according to the season of the year, and whether one is indoors or out of doors ; but the rule of 1 pound weight of clothing to 1 stone weight of the body may pass as a fairly broad rule to stand by. The expenditure of heat, therefore, by the skin is capable of being modified by clothing, and is the only channel over which we have direct control.

The constant activities, chemical, muscular, and functional, which take place in our bodies represent an amount of energy expended estimated at 260 foot-tons in twenty-four hours. The organs of circulation, respiration, digestion, and excretion are in a state of greater or less activity night and day, during sleep and during our waking hours. In this they differ from the nervous and the muscular systems, for these require a certain portion of the twenty-four hours to be set aside for complete rest—*i.e.* for sleep.

2. Internal Work.

Of the organs devoted to internal work the heart has by far the most to do, and the condition of the heart is so vital a consideration to the economy that the meaning of its work must be considered here.

The Work of the Heart.

The heart, as we have seen in earlier chapters, is composed of muscular tissue arranged so as to enclose four chambers, two on the right side and two on the left. From the cavities on the right side the blood is driven onwards to the lungs only, but the cavities of the left side have to do with the propulsion of the blood to the body generally, from the head to the toes and to every organ. The work thrown, therefore, upon the left side, and especially upon the cavity—the left ventricle—which actually propels the blood into the arteries, is by far the greater.

Upon the state of the heart muscle the blood supply of every organ and tissue of the body depends. If the heart muscle is feeble from any cause, be it disease or want of exercise, then is the circulation of the blood in every organ and tissue of the body enfeebled, and the functional activity impaired. If, from disease or from an inordinate amount of exercise and training, the heart muscle be developed to so great a degree (hypertrophied, as it is technically called) that the blood circulates in too great quantity, then may the organs and tissues of the body become congested, and their functional activity be interfered with. Upon a normal state of the heart muscle, therefore, is every part of the body dependent for healthy work. Other organs, of course, contribute their quota to the general health, but in the absence of disease the condition of the heart muscle is the test of a person's actual strength and power of endurance. A man is said to be as old as his arteries—meaning that the state of the arteries determines the physical age, as distinct from the real age judged by the number of years actually lived. So it may be said that a man is as strong as his heart muscle, for physical strain and exertion primarily test the heart muscle, and the actual

strength is really the strain that the most feeble part of the heart muscle can bear with impunity. It cannot therefore be wondered at that the heart and the blood-vessels are for ever being examined by physicians, whether to detect disease or to gauge the propriety of allowing young, middle-aged, or old persons to take particular forms of exercise.

3. Muscular Energy.

Of the three channels by which energy is expended, heat, internal work, and muscular exertion, the last-named alone is under the direct control of the will of the individual. As we have seen, the amount of energy assigned to muscular exertion is but 300 foot-tons out of the grand total of 3,400 foot-tons expended daily by the body. The amount seems proportionately small, especially when we consider that upon the proper use we make of this available force our health largely depends; for it may be safely asserted that the health of the individual varies with the amount of the 300 foot-tons of available energy he expends, and how and under what conditions the expenditure is made. A man or woman who takes too little exercise, or who is employed at work that requires but little exertion, and who does not supplement it by other exercises such as walking, will in time "run down." To such persons exercise is a labour, fatigue and tiredness their chronic state, and physical efficiency unknown. On the other hand, the man or woman who takes too much exercise, or who over-trains, expends more than the 300 foot-tons normally available, and in a short space of time becomes physiologically bankrupt. The physically normal person is one who contrives to expend in a rational manner as nearly as possible the muscular strength he is endowed with under the most favourable conditions obtainable. The man who is at work in an office from morning till evening, and who supplements the deleterious effects of office life by practising in a badly ventilated gymnasium, is not taking exercise under favourable conditions; but could the exercise be taken in the open air his condition would be bettered, and he might, if the exercise is rational and proportionate to his strength, in this way counteract the effects of an indoor employment.

Why Exercise is Necessary.

A man or woman whose vocation necessitates an indoor life requires physical exercise beyond the exertion expended in his or her calling; it is a necessity if one is to keep physically fit. The man who stands beside a machine in a factory for a whole day no doubt feels fatigued and exhausted at the end of the day's work; the girl who stands at a

counter serving customers for the best part of the day feels the want of rest at the close of her labours. One is apt to think that persons engaged in work of a kind necessitating standing for hours together have had enough muscular exertion. Not so. Standing still is always a trying ordeal ; certain groups of muscles are called into play, and great demand is made upon them without any acceleration of blood supply from the heart ; for the heart is not exercised or stimulated by standing. The muscles, being in a state of contraction, demand more blood, but this being denied them, the blood within them tends to stagnate in the vessels, the vessels themselves dilate or may become varicose, and a feeling of fatigue and exhaustion supervenes.

The natural antidote to fatigue thus induced would seem to be rest ; the inclination to rest is there, and one is apt to succumb to it. Physiologically, however, the real antidote is exercise ; to the person who stands during employment, exercise—be it walking, or joining in some game as tennis, or in gymnastic exercise—is absolutely necessary if the evil consequences of long standing are to be counteracted. By exercise the circulation of the blood is stimulated, the heart is strengthened, the tendency to stagnation of the blood in the muscle is prevented, the strength of the fibres in the muscle itself is improved and they are rendered capable of better enduring the strain of long standing.

The driver who sits on his cab, carriage, or van for the chief part of the day feels disinclined to take exercise for another reason ; his lower limbs, from want of use, readily become tired when he commences to walk, and he thinks that it is rest he requires. His muscles are not fatigued, as happens in persons whose employments necessitate long standing ; he is not fatigued, but tired owing to atrophy—a wasting from non-use—of the muscles. The cure for the driver's tiredness is a sharp walk, by which not only will the muscles be improved but the heart strengthened, the circulation improved, and the deleterious effects of what is really a sedentary life thwarted.

It is obvious, also, that the clerk and typewriter, the artist, the student, and all confined by nature of their work to an indoor life, require exercise to keep them fit not only physically but mentally, for the brain and the hand need the stimulus of a quickened circulation and a healthy heart to perform successfully their several avocations. That persons engaged in any of the above-mentioned employments require to take exercise apart from their daily duties seems easy

enough to understand; but assert that men whose lives are largely devoted to certain athletic pursuits should also require to take exercise other than that obtained at their particular pursuit seems an anomaly. Few games are a sufficient exercise in themselves. The cricketer, the oarsman, the jockey, the gymnast and all engaged at indoor games, if they wish to obtain and retain complete efficiency, must take exercise apart from their special pursuits. The billiard player will fail unless he has exercise over and above walking round a billiard table. Neither the pianist, the violinist, nor the singer obtains sufficient exercise from his calling; and, in fact, except perhaps a postman or a golfer who can be almost daily on the course, practically every man and woman, whatever their duties or position in life, require exercise in addition to the muscular energy they expend upon their daily employment.

Athletic Pursuits Insufficient.

To be physically fit implies the possession of a reserve of energy over and above that required for the ordinary duties and avocations of life. A man following only the ordinary routine of city life may be taken as example to illustrate the meaning of this axiom. Suppose him to be living, say, in a suburb of a large city. After breakfast he proceeds to the railway station, some few minutes' walk from his own door. After reaching the city terminus, a walk of a few minutes takes him to his office. During office hours the muscular expenditure necessitated is usually quite infinitesimal. He proceeds from the city to his house in the evening by the same route, and if it be winter he spends his evening indoors, and in summer he may stroll round his garden plot, if he has one.

Reserve of Strength.

This man may well ask, Why is it necessary to take exercise? The sketch of his routine of life just given does not seem to require of him more than a minimum amount of muscular strength, and if this amount is forthcoming and sufficient for the daily task, why is it necessary to take additional exercise, such as extra walking?

At first sight this seems an unanswerable question, but a little consideration of the matter will show the fallacy involved. A man possessed of sufficient strength to carry him through his daily work and no more is by the evening at the end of his physical powers. He has expended all his available energy, and if rest did not come at this point he would be calling upon his physical powers to do what they were unaccustomed or unable to do, and thereby speedily induce fatigue and exhaustion.

In course of time the machine-like regularity of the life he leads causes his heart muscle to be reduced in strength to meet the daily needs and no more. He is on the borders of physiological bankruptcy every evening, and the dangerous proximity of becoming altogether bankrupt is for ever present. He is in an unenviable state of imminent and possible danger. Should he for any reason be called upon to do extra work in his office, to walk a longer distance, or should he be confronted with illness in his family, necessitating want of sleep and anxious care, or should he himself become ill, he has no strength in reserve to fall back upon, and there is a " breakdown " of a serious nature.

The inevitable result of living with no reserve to draw upon in the hour of necessity, with limp muscles and a feeble heart, places such a man in a state of extreme danger. Should he run to catch his train, should he hurry upstairs, or walk at a quicker pace than usual, he gets out of breath quickly, feels his heart palpitate violently, his face becomes congested and purplish or of a livid hue, and he has to stop or gasp. If he is an old man his blood vessels may dilate or burst, and apoplexy—that is, hæmorrhage on the brain—may ensue.

What Getting Fat Means.

As middle life approaches, and a man takes " things more easily," there is a great tendency for an accumulation of fat to take place in the abdomen, giving rise to the protuberant abdomen, or what is vulgarly styled a " pot-belly," and sometimes aldermanic proportions. This increase in girth is considered by many people a sign of strength and burly physique; and it is by some considered an invariable and natural accompaniment of middle age. Quite the reverse is the case, however. Increasing girth means commencing degeneracy, incapability of endurance, and an indication of physiological decline. One can tell fairly well as middle age advances how long one is likely to live. The man with the " big stomach " which increases with years will never live to old age. If after sixty his girth increases, the age of sixty-seven will probably see the end of him; but on the other hand, the man after say fifty-five who gets slowly and gradually thinner, not quickly as in disease, should with ordinary care (provided no accident befall him) find his life prolonged well beyond seventy or to extreme old age. A man otherwise spare and of insignificant physique may yet have a large and protuberant abdomen. This is of all physical proportions the most deplorable, and indicates an effete frame and enfeebled body. The " big-stomached

skeleton," as it has been termed, is the feeblest of all specimens of the human race.

A Good Physique.

The best rule by which to estimate physique may perhaps be summed up in the query: Is the man proportionately built? His head should be in proportion to his body, his chest to his abdomen, and his limbs to his trunk. Actual measurements are not available, nor for general comprehension are they necessary, for everyone is a judge of such proportions.

One rule as to proportion is, however, capable of demonstration. The circumference of the chest should in a healthy man be some inches, at least, greater than that of the waist. When the girth of the abdomen exceeds that of the chest the man is not physically fit; he is incapable of endurance, and the least extra exertion causes discomfort and signs of physical incompetence. His heart cannot respond to the calls made upon it, and consequently the system is thrown out of gear.

Physical Fitness.

We have already pointed out that to be physically fit implies not only that a man or woman possesses the amount of energy and strength necessary to carry him or her through the day's work, but that a reserve of strength and functional activity is always present and available to be called upon in case of need. The heart should be maintained in a state of strength or fitness somewhat in excess of the ordinary daily needs. Likewise all the organs should possess a similar reserve of functional capacity. The digestion should not be tested daily to its full capacity, the brain should not be worked to exhaustion, nor the muscles to extreme fatigue. All our organs and muscles must be so maintained and conserved that they possess a reserve power, in order that they may respond without detriment to the system when they are called upon for extra work or exertion. Their condition lies at the root of fitness or efficiency, both physical and mental. It matters not what one's calling in life may be, every functional or muscular activity should be kept at a level in excess of ordinary needs. To be "fit" and to feel "fit" implies the possession of a reserve of power or strength for work. Even the farm labourer, accustomed to expend a large amount of the 300 foot-tons of energy available, must be muscularly endowed beyond the requirements of his daily routine of work, so that when the strenuous work of seed-time and harvest is upon him he can meet the occasion without over-taxing his heart.

The soldier, the postman, the cyclist, and men engaged in pursuits

which would seem to indicate a physically fit state from the nature of their work, must possess this reserve; otherwise, during an extra long march or fatiguing manœuvres, the soldier will fall out from the ranks owing to deficient "staying" power—that is, his heart muscle is unequal to the demand made upon it. The postman, who performs his daily round with machine-like regularity, should the weather be bad, the roads heavy, or his letter-bag extra full, will "feel the strain" unless he possesses a reserve of strength. Cycling evils are attributable to the same cause—namely, a want of sufficient heart and muscle power to accomplish the extra distance it is at times found necessary to do.

If this is true of those engaged in muscular work, how much more is it the case in those who follow sedentary lives! The literary man, the student, the clerk, and the school teacher must be possessed of a reserve of mental power, otherwise the work will be badly done and ill-health will supervene. The axiom that a healthy mind must be accompanied by a healthy body will hold good for all time; for though there are examples of great mental activity combined with bodies that are far from robust, a man may be healthy enough although not robust, and continue to do good work, provided the strength is not overtaxed by the work engaged upon. A reserve of strength and power, we repeat, is the goal to be striven after, and it is necessary to see how this is to be maintained.

Exercise Defined.

Exercise in its usual acceptation means muscular exertion beyond the amount expended during work. It is something added to our daily employment—an extra, in fact. None the less, however, is it a necessity, and it cannot be neglected if one is to keep well, to remain physically fit, and to possess that reserve of strength which means "fitness" and accompanies efficiency. Exercise wisely taken—that is, adapted in due proportion to each individual's bodily needs—is essential to the maintenance of health, to efficiency at work, to good digestion, longevity, and even to attaining happiness. Men and women, at the end of their day's work, may be wearied and fatigued; their inclination is to rest, and to declare that *their* employment takes so much out of them that it is not possible to take exercise.

Unless the tendency to "rest" when the feelings of fatigue supervene is counteracted the condition gets worse—the palpitation felt in the region of the heart on mounting stairs or ascending an incline,

is believed, after a time, to be due to "heart disease," and the belief engenders yet further abstinence from muscular exertion. A chronic invalid is thus manufactured, and the condition feeds upon the evils which caused it. It is difficult to persuade persons in this state of physical deterioration that their state is curable by exercise; that the aching in the limbs, the shortness of breath, and the weak heart will disappear with exercise, and the fat in the abdomen will be dissolved as the heart is strengthened. Unless there is actual disease—that is, disease of the valves of the heart—shortness of breath and palpitation can be obviated by the very thing that causes them; if going up an incline causes respiratory or heart throbbing, if ascent of a few steps of a stair ends in "puffing and blowing," advise such persons to continue to ascend a hill or steps of stairs until these signs of distress become less or disappear altogether. There is no disease, only muscular inability; for just as one strengthens the muscles of the arm by dumb-bells, so is the heart strengthened by its muscular fibres being called upon to send the blood through the body with increased force during exercise.

Choice of Exercise.

Amongst the multiplicity of exercises, natural and artificial, which are nowadays commended as health-giving, it cannot be wondered at that confusion exists in the public mind which to follow. On the one hand we have gymnasia advertising for pupils by pamphlets adorned with pictures showing what is considered to be the perfection of muscular development. In another pamphlet we have the benefits of Swedish exercises upheld, and the superiority of this form of development over all others. Others advocate breathing exercises, movements without apparatus, the use of developers, jiu-jitsu, and a host of allied methods and contrivances at once ingenious and no doubt in some instances beneficial. At the present day it is customary to regard institutions of the kind as a branch of medicine, and to look upon the pupils as semi-invalids. The gymnasium has been, we are told, brought up to modern requirements by being run on physiological lines, and the pupil is looked upon as a "case" to be treated.

This may be sound in principle and useful in practice, but it implies a feature of modern life which is far from satisfactory from the standpoint of national physique. The fact is that the conditions and environment of life in large cities have so far removed us from the rural and more natural mode of living that our whole being is more or less spent

in an abnormal setting. Are we developing abnormal beings? It would appear to be so if the tone of many of our institutions for development and exercise is taken seriously. It may be right that this tone should prevail, but it implies to a certain extent a condition of semi-invalidism in our city dwellers which would seem to point to a physical deterioration.

Principles of Exercise.

How, then, is one to choose which system of development and exercise to follow? To establish principles to guide us in the choice of exercise, it is necessary to consider man's estate before he became the denizen of a large city. It is little more than half a century since the majority of this nation became city-dwellers. Before that time cities were fewer and of much smaller population. The advent of steam brought machinery, factories, and the grouping of huge populations around the factories. The cities grew rapidly, unscientifically, and consequently unhygienically, with the result that Nature was excluded, and a new being—the modern town-dweller—was produced. We are now commencing the third generation of pure-bred town dwellers, and the prospect is alarming. We have not learned either the science or the art of how to live in towns. Much has been done to ameliorate the thoughtless aggregation of large numbers of people in a compressed area. The introduction of good drainage and water supply, the creation of open spaces, the foundation of garden cities, the establishment of the "week-end" holidays, indicate the directions in which efforts have been and are being made to render town life possible, and the desire for a reversion to a more natural and rural environment a necessity.

In early times of the human race, as we have seen, man cultivated the soil or followed the chase: these were his sole callings; and if we are to establish forms of exercise based upon natural laws it is necessary to take these as our types. The first principle, therefore, to be enunciated would appear to be that our artificial exercises should resemble the muscular acts required by man in his more natural state. The agricultural labourer and the gardener are the only sections of the community which approximate man's natural employment. Even these callings have been modified, for machinery has found its way into our fields and farms. The steam plough, the reaper, and the laying down of crops by machines have rendered ploughing, mowing, and sowing by hand labour almost obsolete in some parts of the country.

THE "WRESTLERS," IN THE UFFIZI GALLERY, FLORENCE.

Another axiom which it is well to establish, when artificial exercises are being considered, is this—that any exercise which tends to the development of the upper extremities to the neglect of the lower is unsound in principle, and should be discouraged.

Monstrous Biceps.

This should be well considered and acted upon, for the tendency is all the other way. The upper extremity is, in our modern gymnasia, developed to a degree which is wholly abnormal, and quite useless as a factor in health. How often do we see in advertisements of systems of training the picture of a man showing an arm of huge dimensions; the biceps stands out like a leg of mutton in the front of the arm, and the bulgings pictured in the forearm indicate the possession of muscles of great development. The idea of the advertisers is, no doubt, to attract pupils to come to his school to be made like unto the picture. But the picture should repel and not attract; to have one's arm trained to the "perfection" represented is mere waste of time so far as health is concerned. An arm of such dimensions is trained beyond the needs of man. Neither the farm labourer nor the blacksmith has an arm of the dimensions of our gymnasium athlete. They represent, perhaps, the two callings requiring the most powerful arms, yet are their upper limbs quite insignificant alongside those of a city clerk who is trained under certain systems. The hand is a delicate instrument in every calling, and the conversion of the muscles which cause the movements of the hands into hugely powerful masses is unnatural and useless.

Where Strength should be Developed.

Man's strength is not naturally in his upper limbs, but in his loins and thighs. Our strongest men of recent years—such as Captain Webb and Donald Dinnie—were not the products of gymnasia. When one studied their anatomy one could not help being astonished at the rather meagre development of their upper limbs, and even of their legs below the knee, and it was only when the loins and thighs were seen that one gathered where the secret of their extraordinary strength lay. In Greek and Roman statuary the loin and thighs of the athlete are the parts depicted as of extraordinary development and, as it were, the focal points of strength. The upper limb tapers, even in the disc throwers, from the shoulder to the hand without any great bulging of muscles. There seems neither historical nor practical justification for the modern

excessive training of the upper limb. That it is strengthening to the "system"—meaning thereby beneficial to the heart and digestive organs generally—to any marked degree is doubtful. No doubt the instructor can show an increase in chest development, a real advantage when the chest capacity is actually increased; but usually the so-called chest development is due to an increase in bulk of the muscles passing from the trunk to the shoulder, and not to an expansion of the chest.

The man with upper limbs highly developed is generally endowed with lower limbs of rather meagre proportions; the knees are often inclined to a knock-kneed condition and the feet tend to flat-footedness. He is disproportioned; had he spent more time in exercising his lower limbs his general state of health and development would have been better.

Advantages of Exercising the Lower Limbs.

As a rule, the upper limbs are brought into a high state of muscular power by exercises at home or in a gymnasium. Neglecting for the moment the disadvantages of exercise taken indoors compared with exercises practised in the open air, there is yet another aspect in which upper limb exercises are defective. They are practised for the most part whilst standing almost still. There is a strain thrown upon the heart and lungs without a corresponding increase of circulation or a quickening of the heart's action. The breathing is apt to be restrained or "held" during the exercise, leading to tension on the valves of the heart and the heart muscle as well as on the air cells of the lungs. It is impossible to be certain of the amount of force expended during any exercise of the upper limbs, especially when apparatus is being used. Fixing the chest is almost necessary during arm work in order to afford a fixed point from which the muscles of the shoulder, having their origin at the chest wall, act. Fixing the chest wall means that the breath is held, necessitating strain on all the organs of the chest and abdomen. These are a few of the drawbacks to throwing much work on the upper limbs in the way of lifting weights, using apparatus during exercises, climbing ropes, or any one of the many devices and contrivances practised in gymnasia.

The upper limb, in contradistinction to the lower limb, is a sensitive organ, capable of infinite possibilities in the way of training to perform the most delicate work. It is the organ by which we feed ourselves

in a double sense ; not only do we prepare and convey our food to our mouths by the hand and arm, but it is the food-earning organ as well, and it would seem rational that its chief feature should be to retain a delicacy of touch and a suppleness of movement. That these traits are improved by developing the arm muscles to a state beyond all possible needs seems questionable ; it may not be too much to say that the greater the muscular attainment the less the delicacy of the hand. The arm and hand of the normal woman, in contradistinction to the over-developed and therefore abnormal arm of the athletic woman, is endowed with the highest capacity for work requiring delicacy and touch. The introduction of an inordinate and unnecessary amount of unsuitable exercises for women has given them a distaste for refined work. The cause is physical rather than social ; for the upper limb of girls following the "advanced" or muscular regimen of to-day is capable only of gross accomplishments.

The lower limbs, on the other hand, have functions altogether different from those required for the upper extremity. Their work is gross and muscular, and every method by which their strength and capacity is developed in harmony with the wants of the body is legitimate and beneficial. Upon the perfection of the lower limbs much of the health of the system depends, and perhaps the condition of the feet is of the first importance for the maintenance of health.

Sound Feet.

The value to everyone of normal feet is incalculable ; yet how few people possess them ! Few adults, men or women, are proud of the appearance of their feet ; few are ready to present their feet for examination without some excuse, such as, "I am troubled with corns and bunions, and cannot understand why." Others display callosities, or a bent toe which is stated to be a "family toe," as "all our family have it." Deformity in some form is the rule—the toes are huddled together, the big toe is distorted so as to overlap the second, and the smaller toes are misshapen ; and for the purpose for which the foot is intended—namely, to walk upon—the conditions are unfavourable, and long walks or marches are well-nigh impossible. No one with distorted feet can be physically fit, for unless one is capable of taking walking exercise as it should be taken, the general health must be defective. For the soldier, the sailor, the sportsman, and for almost all forms of games a normal foot is essential ; and for everyone it is an important matter to be sound-footed. Yet of all

parts of the body is the foot most subject to deformity ; no other part, not even the waist in women, is so misshapen by wearing apparel or by any other means. The cause of the distorted foot is badly fitting boots or shoes, and, to some extent, tight and shrunken socks—there is no other cause. The fashion is to have the toe of the boot in the centre, and the big toe is pressed out of shape to correspond with the boot. The foot nowadays is made to fit—or rather misfit—the boot, and not the boot the foot.

The man or woman who desires to be physically fit must have a normal foot and a boot made to the actual shape of the foot. For without these sufficient exercise cannot be taken, and deficiency in the amount of exercise means in course of time deterioration of physique.

CHAPTER XCIII

VARIOUS FORMS OF EXERCISE

Walking—Amount of Walking Necessary for Health—Nature and Mode of Walking—Walking an Hour at a Stretch—How, When, and Where to Walk—Infants' Outings—Exercise for Children—School Exercises—Exercise for Women—The Pelvis in Women—Exercise for Old People—Home Exercises.

WALKING

COMPARED with the multifarious uses to which the upper limbs may be put, our lower limbs have but a limited scope of action. Progression is the main use and purpose of the lower limbs, and to be able to walk well is a vital necessity for the maintenance of good health. This implies, as we have seen, normal feet and well-fitting boots or shoes, and, given sound organs, everyone can practically command good health provided a sufficiency of exercise is taken.

Force Expended During Walking.

A man weighing 154 lbs. (11 stones) during a walk of one mile on the level expends 17·67 foot-tons of energy. Should, however, a bag be carried, or a knapsack and rifle, the amount of energy expended rises in proportion to the weight carried. The amount of force the soldier expends in walking a mile with 60 lbs. weight of kit and accoutrements is no less than 24·75 foot-tons; and for every additional pound of equipment carried the expenditure becomes naturally greater. The additional weight, moreover, means, as a rule, a slower pace, and hence a longer time spent in the accomplishment of a given distance.

A simple calculation should, with the knowledge before us, reduce the amount of walking exercise necessary to maintain health to exact figures. Accepting as the basis of the argument that 300 foot-tons of muscular energy are daily available for the use of the body, and that 17·67 foot-tons of energy are expended every mile, it will be readily seen that it would be necessary to walk almost 17 miles daily to expend the 300 foot-tons in exertion ($17·67 \times 17 = 300·39$). But to accom-

plish this it would be necessary to walk for about five or six hours daily, an amount of time it is impossible for anyone who has his livelihood to earn to give to exercise of the kind. In studying this problem, which is of great importance to everyone, there are several considerations which serve to reduce the matter to practical possibilities. Of the 300 foot-tons of available energy, much of it is expended in the ordinary avocations of life. Dressing, going up and down stairs, even sitting at work, the short walks in and out and about one's home, sewing, piano-playing, and the thousand and one affairs of house, home, office, or workshop, necessitate an enormous amount of muscular expenditure, and reduce the quantity to be expended during the "constitutional" walk to proportions which are within the power of everyone, however employed, to fulfil.

Amount of Walking Necessary for Health.

To maintain health it is necessary for everyone, however employed, to walk for at least one hour at a stretch at a good pace. The pace is an important item. To stroll slowly along "looking at the shops," or accommodating one's pace to suit slow walkers or invalids, is not calculated to do much good to the physique. The object of the walk is to strengthen the heart muscle and increase the rate of circulation and breathing. A stroll or walk at a slow pace will not accomplish the ends desired. The heart is given nothing extra to do, nor is it stimulated to action beyond an infinitesimal amount. Curiously enough, it is a fatiguing progress to slowly stroll or to stand about—much more fatiguing than a walk taken at a good pace; a quick walk is stimulating, and if kept up for some time one may feel tired but not fatigued—a totally different feeling. Fatigue is due to an accumulation of blood in the muscles owing to deficient stimulus to the circulation to drive the blood along; tiredness is felt when the muscular fibres have been exercised beyond their wont. Fatigue is attended by weak and imperfect contractions of the heart muscle; tiredness, unless extreme, by increased force and rate. The former is deleterious; the latter is calculated to do good.

The slow march of the soldier is officially given as 76 paces a minute; in the quick march 116 paces per minute are taken. But 116 paces when walking alone will be found anything but quick walking. An army moves slowly; there are many reasons for this, and 12 to 15 miles a day for a body of troops on the march is considered a

good distance. For one thing, the soldier marches with a heavy kit and with accoutrements weighing in all perhaps 60 lbs. The muscular expenditure per mile when carrying this weight is not 17·69 but 24 foot-tons, and this difference tells in time.

Another factor that counts in walking is the gait and length of step. Every individual has his or her own gait and length of step. To curtail the natural step to suit the shorter step of a companion is a muscular effort in itself; the whole gait is altered, and tiredness ensues more readily than if one walks naturally. To lengthen one's stride to suit that of a companion is also an effort that soon tells. Keeping step, as in military parades, tends to slow the rate of marching and to cause tiredness sooner than if "marching at ease" or marching out of step is allowed. Whilst walking alone the gait and length of step allow of natural movements, and the distance covered will therefore be greater, and there will be a good deal less fatigue and muscular effort.

Mode of Walking.

To estimate the rate of walking one should walk for a time with watch in hand, and count the number of steps per minute. After a time one can tell fairly accurately the rate of step without the watch, but it is well now and again—not to speak of the interest attaching to the observation—to gauge it by the watch. Most people who take a "constitutional" walk get but little good thereby except by "taking the fresh air." This, however, is a waste of time in a great measure, for if in addition to the "fresh air taken" further good can be got by a little attention, it is of great advantage to give it. The chief object of the walk is to strengthen the heart muscle, and this can be done by walking at a pace somewhat in excess of one's natural pace. It is this slight increase in the rate of walking which gives the heart extra work, and by it the muscle of the heart is strengthened slightly beyond the ordinary bodily needs. It is by attention to this fact that reserve force is acquired and the heart is made capable of bearing the strain when any extra calls are made upon it.

Pace.

To walk for an hour on end has quite a different effect upon the muscles, and especially upon the heart muscle, from walking, say, half an hour at one time and half an hour at another. A weakly person or an invalid may be able to walk for, say, fifteen minutes, and then, after a rest, go on again. The "City man" living in the suburbs

may walk for, say, half an hour on the way to the nearest station in the morning and for the same time on the way home at night. None of these efforts, however, is sufficient to afford the maximum of good. The truth of this statement can only be proved by actual experience. Let those who have doubts regarding the matter try it. At first a walk at a pace beyond the usual rate, kept up for one hour, will produce aching at the calves, in the thighs, and perhaps in the loins ; the heart may be felt to be throbbing, and the skin will be covered with perspiration. These signs and symptoms are taken to be harmful, and unless this idea is got rid of there is danger of relapsing to less efficient measures.

Walking an Hour at a Stretch.

Even for walking one wants to be trained to walk hygienically. Commence at a moderate pace, say, 116 paces per minute, and walk on the first day for half an hour at a stretch. On the following day increase the time to three-quarters of an hour, and finally to one hour. When this can be accomplished comfortably, increase the rate to 120 paces per minute for the whole or at least a portion of the hour's walk. Keep this up daily until a rate of 120 paces per minute can be taken for a full hour. Again increase the pace to 125, and finally to 130 paces per minute. A walk for one hour at a stretch at a rate of 130 paces per minute will keep a man in good health. He will build up a reserve of strength which will give him the feeling of " fitness " which constitutes the enjoyment of living ; he will not so readily break down when any slight extra physical strain is thrown upon him, and he will find work a pleasure instead of a task. Digestion will improve, and the rotundity of the figure—in other words, the fat in the abdomen —will diminish.

Fat in the abdomen, causing the rotund figure, means more than mere increase in girth. The fat in this part certainly interferes with the power of breathing, hampers the functional activity of the stomach, liver, and intestines, and also betokens fat accumulating elsewhere, notably around the heart. But a heart covered with a layer of fat is a feeble organ ; it flutters or throbs unnaturally when a stair is ascended ; it gives out when the pace is quickened or an attempt at even a short run is made ; and the doctor is consulted as to heart disease. In time, no doubt, actual disease will follow, for fat around or on the heart will in time impair the nutrition of the heart muscle itself, and a " fat heart " may be followed by degeneration of the muscular

fibres of the heart—"a fatty heart." These physical drawbacks may be checked, cured, or prevented more economically and more safely by walking performed in a proper or hygienic fashion than by any other form of treatment.

How, When and Where to Walk.

No one is so busy or so closely engaged in work that he or she cannot take exercise for the space of one hour daily; no one can be in good health unless this is done. No one is doing his or her life's work thoroughly or efficiently by neglecting to take a sufficiency of exercise; without it, healthy middle age or healthy, old age is unattainable; and, what is of greater importance still, a healthy offspring is impossible.

The town dweller may well ask, How is it possible to take exercise if I have no time to do so? and if I had, where can I walk in a crowded city? Office hours are from 9 or 9.30 to 5.30 or later; how is it possible to spend (or waste) time in walking? Walking is a monotonous form of exercise, and a "constitutional" is for old age, not for youth.

These apparent difficulties are apt to become real when reduced to a practical issue. Everyone knows how difficult it is to follow a regimen for any time, to say nothing of making it part and parcel of one's daily life. This may be true, yet is it equally true that unless some form of physical exercise is taken regularly, ill health will ensue; it may be early in life, it may be deferred; but the day of retribution comes as certainly for sins of omission as for those of commission, be they physical or moral. Although we find ourselves in an environment which hinders our following a healthy mode of life, that does not affect the incontrovertible laws of health. Our environment is the result of the circumstances of modern life, which in city life amounts to a departure from man's original place in Nature. The whole question, therefore, resolves itself into the maintenance of health in the circumstances of modern city life. Few city workers live over their offices, as in former times; the more active business parts of our cities are practically deserted at night, and all "office folks" would sleep out of the city if they could afford it. For these, suburban residences are available, and going and coming by rail or tram is a morning and evening event.

The day's routine for this section of the community is usually as follows: A rather hurried breakfast, a hurried short walk to the nearest station, a smoke and a newspaper in the railway carriage; business until 1 p.m.; luncheon at a restaurant, in some cases a cup of tea about

4 p.m., home by rail with a pipe and a newspaper, dinner or supper, and some evening diversion until bedtime. Where and when is there time or opportunity for a walk or exercise ?

A man so situated can keep himself fit and healthy by taking a walk for one hour either before or after business hours. From April to October he can get a walk in daylight before or after the usual office hours ; from October to April only in the morning. Every man living within a distance of four miles from his office should walk in summer the distance either before or after his office hours, either to or from his home ; in winter the walk should be taken in the morning. Every man living at a distance greater than four miles from his office should walk a similar distance, and take rail or tram for the remainder of the distance.

The Daylight Bill, were its principle to be adopted by the country, would go a long way towards rendering the axioms here laid down easy of accomplishment, and from the point of national health would prove a factor of the highest importance. But even as daylight is utilised now it is quite possible for those who value health to take the hour's walk necessary. Were breakfast taken at 8, by 8.30 one should be ready to start and to walk for one hour, and yet reach office by 9.30 ; should the hour of business be 9, an earlier breakfast will allow of the same being done. If the evenings are light, a walk from 6 to 7 or 7 to 8 may be substituted. Walking along crowded thoroughfares and uninteresting streets is not inspiring, and walking on pavements is trying at all times. Fortunately, we have parks in most large cities, and a portion of the walk may be across one of them. Residents in cities as distinct from suburbs can always find a park to walk in, and for them also there are tubes, trains, motor 'buses, affording quick and cheap transit, so that they can have their exercise in the more open parts around our cities.

For city dwellers, therefore, for whom walking is the only available exercise, a walk for one hour daily should be taken, at a pace slightly in excess of the natural rate of walking, at any time of the day convenient.

INFANTS' OUTINGS

Every infant over a month old should be taken into the open air for an hour or more once or twice daily. The perambulator is the vehicle in which the outing is usually taken, and although there is much

to be said against it from a hygienic point of view, it has become a necessity of our civilisation. Mothers or nurses before the advent of the perambulator carried their babies in their arms, the baby being kept warm and supported by a shawl which enveloped both mother and child. The perambulator never can be made to supplant carriage by the mother when the matter is considered from a hygienic point of view. Carried in a shawl, the infant is kept in contact with the mother's body, and an equable temperature is maintained, the exact temperature the infant requires—namely 98·4, the normal temperature of the body of child and mother. In the perambulator this is impossible ; the temperature of the air, and consequently of the perambulator, varying with the season and the weather. If a hot bottle is put into the perambulator the heat also varies ; now too hot, and the child perspires ; now too cold, and the child gets a chill.

However, mothers and nurses in America and Britain, and in many parts of Western Europe, refuse to carry infants, and the perambulator has become a matter of course. It may be that the women of to-day are physically unfit to carry their babies in their arms, although it is put down to other reasons, such as being unfashionable and the like. In other parts of the world, however, babies are carried by mothers or nurses sometimes on the arm, sometimes on the back in bags, or again on the hip ; and the temperature of the infant is maintained at a constant level. The perambulator has yet a further disadvantage, inasmuch as the child is made to lie down with the light full upon its eyes—a species of cruelty which does not seem to have come as yet under the notice of the Society for the Prevention of Cruelty to Children.

EXERCISE FOR CHILDREN

To take a child of from three to eight years of age a "set" walk daily might well be classed as a minor species of cruelty. Children of the ages in question, when "taken for a walk" by an adult, have a trying time; not only is the monotony of the walk detestable to the child, but it has to keep up with its parent or nurse in a half-run, half-walk, the most trying of ordeals. Let go the child's hand, and it will naturally run on ahead and then wait for its adult companion, and again start off to run when overtaken. A child naturally "plays" or runs ; if it walks, it is at a pace so slow that its parent or nurse seizes its hand and hurries it along, inflicting thereby physical

hardship, or at least great discomfort. The children of the poorer classes in large towns have a considerable advantage over their better-off *confrères* in the matter of exercise; they play around the doors in the streets and alleys, whereas the children of better-off folk are taken for "walks." The child of poor parents has no dressing or preparation before going out; the child of the better class has to be washed and dressed before going out. Preparation for a walk is a function which all children object to, and the whole procedure is one but little calculated to be pleasurable.

School Exercises.

Physical culture, as it is termed in schools, is greatly in vogue at the present day. It is calculated to develop the child's physique, and takes the place of the natural "play" which is the child's constant employment when left to itself. That good results, as a rule, from the formulated exercises set down for children may perhaps be conceded; moreover, it is a species of discipline which is always beneficial when wisely imposed. The fact, however, that the drill or exercise is a "lesson" in the sense that it is a formula to be gone through is detrimental to its being considered of the nature of a game or as "play." It is in danger of being regarded as a drudgery to be endured, and therefore to be stopped as soon as the scholar is free from school discipline.

Drill.

It is difficult wholly to avert this drawback, but it is being dealt with by making the exercise or drill more of the nature of a game—a wise step. It is well to remember that the circumstances of children in a school differ considerably. In towns, schools are seldom so situated that the child has a long walk to reach the school it attends; in country places, however, it is different. A child who has a walk of two or three miles in the morning and the same distance in the evening on its way to and from school has had enough physical exercise for the day. In wet weather, when the roads are muddy, when books have to be carried, and, it may be, the midday meal, it is cruelty to insist upon a child thus situated undergoing physical drill or exercise in any form. Teachers must take these features of the case into consideration, otherwise their system will overtax the child's strength. Again, children have frequently to fetch and carry for the parents either before or after school hours, and further disciplinary exercises are not called for.

Drill of a military or quasi-military type is of dubious benefit to children; it becomes monotonous and distasteful, and inflicts at times

some actual physical hardship. School exercises should, when possible, be conducted in the open air; theoretically, every schoolroom should have a movable roof opening to the air; but in storeyed buildings this is an impossibility, and could only exist if schools were built in single storeys.

All exercises for children should be without apparatus, and it must be remembered that it is the lower limbs, not the upper, that require most to be developed, and that running is more important than any number of arm movements gone through whilst standing still.

EXERCISE FOR WOMEN

A scheme of exercises beneficial to men is wholly unsuitable for women. The sexes differ in their physique and build, and neither the drill instructor nor Act of Parliament can alter this fact. The tendency of the day is for women to imitate men in their exercises and amusements, and to claim equality politically, mentally, and physically. The last of these desires, at any rate, can never be realised, for Nature has set its seal upon the frame. Women can frequently accomplish marvellous feats of strength which, to judge them by the standard of the physical development of men, seem incomprehensible. A man who climbs a rope hand over hand, or who acquires proficiency on the cross-bar, trapeze, etc., seems to require an arm and forearm of marked development; the muscles stand out prominently, and are hard and massive. A woman can perform similar feats, yet her limb seems to have no proportionate enlargement; the biceps and forearm muscles do not assume the large bulk which they do in men. It is possible that, woman being usually a lighter weight, her muscles are not required to reach large dimensions, but even in a man and woman of almost equal weight the same feature is noticeable.

It is, however, when one studies the framework of the lower limbs that the relative physical powers of men and women are to be observed and the limitations understood.

The Pelvis in Women.

The pelvis—the large girdle of bone that surrounds the lower part of the body and serves as a basin to support the organs—is much wider in women than in men. The consequence is that the hip joints, formed by the upper ends of the thigh-bones fitting into sockets on either side of the pelvis, are wider apart in women than in men. Thus it is that the lower limbs of men are straight, while in women the

width above necessitates a greater proximity at the knee, and again a slight divergence outwards as the foot is approached, so that the limb is naturally somewhat "knock-kneed." The conformation is therefore against the attainment of proficiency in running, and especially jumping, and in a lesser degree hampers sustained movements in which the lower limbs are concerned. No woman has ever shown great powers as a runner, nor have women competed with men in jumping, nor is it physically possible for a normally grown woman ever successfully to do so. Girls of say 12 or 13 years can often run fairly well, but after adult years their powers decline in this direction. It is, moreover, undesirable that young girls should carry running or jumping or allied exercises to great perfection, for troubles will certainly ensue, causing lifelong regrets.

Women's Household Work.

Women who are occupied in household duties—and, after all, these form the majority of women—expend during indoor working a considerable amount of energy. Bed-making, dusting out a room, answering calls at the doors, shopping, and the many duties housework entails, are fatiguing, but it is impossible to estimate exactly the amount of energy thereby expended. One item can be estimated fairly exactly; the ascent of stairs necessitates an expenditure calculated as follows: Assuming the weight of the body to be 10 stone (140 lbs.) and the step of a stair to be 6 inches in height, the ascent of one step means lifting the body weight one-half foot—in other words, 70 foot-pounds. Following up this calculation we find :—

Number of Steps 6 inches high.		*Foot lbs.*
1 step		70
12 steps		840
24 steps		1,680
48 steps		3,360
70 steps	(2,240 lbs. = 1 ton.)	4,900

In many houses in towns the steps of the stairs from basement to top floor number 70 or more, necessitating an expenditure, every time the whole distance is ascended, of over 2 foot-tons of energy. If a maid engaged in household work ascends a portion of the stair many times a day, she makes an expenditure of energy equivalent to a walk of several miles on the level. All this must be borne in

mind when advising women as to the amount of outdoor exercise to be taken, for it is readily to be seen that a large call upon the available muscular energy to be expended by indoor work has been made. Moreover, the 300 foot-tons of muscular energy available was calculated in the case of a man of average strength engaged at a full day's work. Allowing the lesser amount available for a woman to be 200 foot-tons, it is plain that a smaller amount of actual outdoor exercise is required. A small number of women only "go out for a walk" daily as a routine practice. Maid-servants, as a rule, are "allowed out" only once or at most twice a week, and when they do go out it is seldom they "go for a walk." In bad weather women are apt to remain indoors for many days together, and it is plain that their duties, their constitution, or some peculiarity of their being, allows of their remaining so long indoors apparently unharmed, for were men to be similarly shut up in the house ill-health in some form would supervene. The cause of this may be that men find but little physical employment indoors compared with women, and although indoor work is not wholly beneficial, owing to the atmosphere of the rooms, yet women can keep well with less out-of-door exercise than men. Still, for women to keep their health, especially in towns, out-of-door exercise for at least one hour daily is essential. Walking need not be so rapid; 100 to 110 paces per minute will suffice.

EXERCISE FOR OLD PEOPLE

Up to 65 years of age a healthy man should be able to take the same amount of walking exercise he did when, say, 40. He should be able to walk one hour at a stretch at a good pace—say 130 steps per minute—without in any way feeling the exertion. After 65 he should endeavour to maintain this expenditure, and it largely depends upon his continuing this amount of walking, and at the pace indicated, how long he will live. About the age of 65 most men take the affairs of life more easily. Many seek retirement and settle down to an armchair and the newspaper; in bad weather they may remain indoors, and on various pretences neglect their daily outing; after breakfast, or at any time of the day, for an old man to fall asleep frequently in his chair whilst reading is a sure sign of senile change, and heralds a rapid decline in health. Suddenly to cease active interest in business and to take up residence on retirement in a suburb is fatal to longevity, unless the tendency to lead a lazy life

is checked. Advancing years bring physical infirmities, due for the most part to changes in the blood-vessels and in the heart muscle. In the arteries lime salts become deposited, the vessels lose their elasticity and become hard and brittle. With hard, narrowed, and inexpansile arteries there is more difficulty for the heart to drive the blood through them, and an increase of exertion brings breathlessness and palpitation, or if the exertion is great the blood-vessel may crack, allowing blood to escape into the surrounding tissues. Should the rupture of the blood-vessel occur in the brain, apoplexy is the result.

It is evident, therefore, that old people must be careful in the matter of exercise, and yet more careful not to allow the tendency to neglect exercise and to sit or sleep overmuch to grow upon them; for this habit will but increase the degeneracy of the blood-vessels, weaken the heart, and hasten the changes in the kidney which so frequently develop about the sixty-fifth year of life. Walking, golfing, or riding are the appropriate exercises for old men; one or other of these should be taken regularly, wet and fine, for a day or two in the house is apt to cause disinclination to move out when the weather clears. Old men have to be careful of over-exertion, especially of running, say, to catch a train, and of lifting heavy weights, for severe straining is apt to cause the heart muscle to give way or a blood-vessel to rupture.

Elderly women are not so apt to injure themselves by over-exertion as are men; they have not, as a rule, been accustomed to put forth strength in great muscular efforts during any period of their lives as men have been, and the liability to forget that they are getting on in years and to attempt to do what is dangerous to the heart or blood-vessels is less in their case than in men, to whom muscular efforts were in earlier years an ordinary habit.

HOME EXERCISES

During recent years there have been introduced into our homes what may be termed bath-room exercises, seeing that they are usually performed in the bath-room, or an apparatus for the purpose is generally fitted up there. These exercises are taken with and without apparatus, and consist of a few minutes' "extension" movements of sorts. For the most part, they are arm movements; the arms may be swung round the head rapidly for, say, twelve to twenty times; the elbows are bent slowly, with the fists rigidly clenched; the hands are applied

palm to palm in front of the body with the arms straight, and then carried forcibly backwards as far behind the shoulders as possible. Other movements are touching the toes with the finger-tips, and sometimes leg movements of various kinds. The last-named are considered of secondary importance, as a rule, whereas they ought to occupy the primary place. It is impossible to describe in detail the many systems and the numerous movements recommended by those who claim to be authorities on this subject; but the following exercises may be taken by everyone with advantage:—

1. Before dressing in the morning, lie down flat on the back on the floor, keep the feet together, and slowly raise the lower limbs until they are at a right angle to the trunk; then slowly lower the limbs to the floor; repeat this again and again until it is felt that one has done enough. This may be only five or ten times, but when this exercise can be done twenty times one may infer that the requisite maximum has been reached. For men or women over 50 years the management of the breath whilst taking this exercise is important. Before commencing to raise the limbs take as deep a breath as possible, and allow the breath slowly to escape during the whole time the limbs are being raised and lowered. This precaution will prevent over-straining during such exercises. Holding the breath when any supreme muscular effort is to be made is always attended by severe strain on the heart owing to the arrest of breathing; in young people this may not cause damage, although it is apt to do so, but in people of advanced years it is always dangerous.

2. Another exercise of great advantage to the frame is to stand erect, hands on hips, then to rise on tiptoe slowly, and then slowly come down on the heels; this movement should be repeated again and again until it has been done twenty or more times.

3. Another movement of practical value is to stand erect, knees and feet close together, with the lower limbs kept quite straight; turn the palms of the hands downwards, press the thumbs together, stretch out the upper limbs in front of the body at full length, bend slowly forward, and touch or attempt to touch the toes. Recover the erect position, and repeat the movement several times.

4. With the upper limbs kept straight, swing the limbs in a wheel-like movement round the head; keep this up for a few seconds, revolving the limbs rapidly.

5. Clench the fists tightly, stretch out the upper limbs straight

from the shoulder, slowly bend the elbows until the fists are brought up to the shoulder ; then slowly straighten the limbs again. Repeat these movements for a few seconds. The same movement may be done with the hands open.

6. Place hands on hips, throw the chest well forward, and inhale deeply, slowly, and deliberately ; then allow the breath to escape slowly ; repeat twenty times. It is best, when the weather allows, to do this at the open window or in the open air.

From all these exercises more benefit will be obtained if they are performed in a well-ventilated room in a free current of air.

There are many other exercises which are recommended by special systems, but those enumerated are the most important and can be done quickly in a few minutes before dressing.

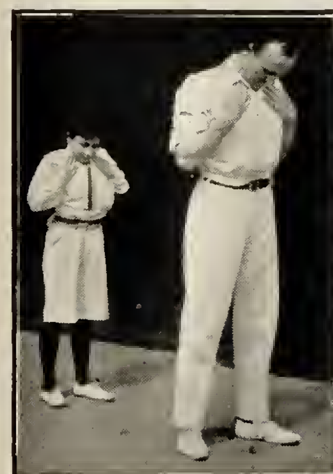
Apparatus.

Dumb-bells, Indian clubs, etc., and several forms of apparatus, such as " Exercisers " of various sorts, wherewith muscular movements may be performed, are found in our homes and in gymnasia. These are commendable as adjuncts in some instances, but they are concerned with the development of the upper limbs chiefly, and do little or nothing to strengthen the lower. The " Exercisers " are usually apparatus easily fixed up in one's room or bathroom, but after a week or two's usage they are generally neglected, and the movements are left off. The elastic cords which in the exercisers give the resisting force become weakened day by day, and therefore become gradually less useful as strength-givers. There is no need for apparatus, dumb-bells, or any other adjuncts : the movements requisite for health are sufficient without them.

.. 1.—Place the hands on the hips and ..se on to your toes as you breathe in, ..en sink down to a crouching position as ..ou breathe out.

FIG. 2.—Take up a position with the right foot at right angles to the left and the arms crossed behind the back. Bend the knees, and take a short step forward.

FIG. 3.—Straighten the left leg and lunge out with the right. At the same time send out the right arm forwards, and the left arm backwards, the palms upwards.



.. 4.—Put both hands on the abdomen, ..nd breathe in through the nostrils as you ..end the abdomen out and the diaphragm ..own. Breathe out thoroughly through ..e nostrils. Repeat, but breathe out now ..rough the mouth.

FIG. 5.—Put both hands on the ribs and breathe in through the nostrils as you send the chest-walls out in front to the sides and back. Breathe out thoroughly through the nostrils. Repeat, but breathe out now through the mouth.

FIG. 6.—Put both hands on the collar-bones, begin to breathe in through the nostrils, then, while still breathing in, draw the abdomen up and send the chest-walls out. Now bend forward from the hips and try to draw the chest-walls in. Then breathe out quietly through the nostrils. Repeat, but breathe out through the mouth.

FIGS. 7 and 8.—With your elbow against your ribs, hold your right hand with the palm facing you. Now clench your hand and turn it round as far as it will go with the thumb to the right. Then, as you open your hand briskly, turn your wrist round so that the thumb comes over from the right to the left. Then use the left side.

COURSE OF EXERCISES FOR BUSY PEOPLE


FIGS. 9 and 10.—Stand in an alert position, but with the chin in, and start with each foot in turn in various directions as if you were beginning a race, but only take one step and then come back to the alert position. Do not grip your hands.



[F]IGS. 11, 12, and 13—Stand in the alert position and, bending your legs as little as possible, stoop down to the right, and with your right hand pick up an imaginary ball. Bring it back as far as it will go behind your ear. Then throw, bringing your hand in front of your face, and finishing up with the first and middle fingers extended. Do this similarly with the left hand.



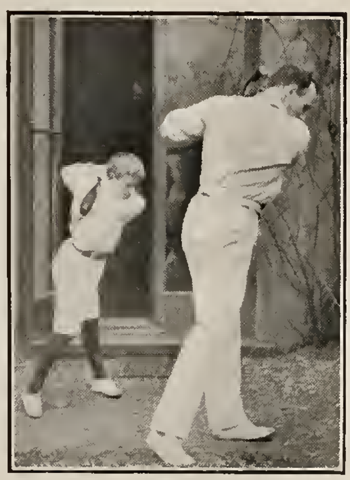
[F]IG. 14.—Draw up your right knee with your hands as high as it will comfortably go, breathing in through the nostrils.

FIG. 15.—Shoot your leg straight in front of you with the toe pointing down. Breathe out through the nostrils.

FIG. 16.—Next try to kick yourself behind with your right heel, holding your ankle with one hand if you like.

FIG. 17.—Bring your right knee up in front of you again, but farther out to the right side.

FIG. 18.—Send the right leg out as far as it will go behind you. Then swing it as far as it will go in front. Then do these exercises with the left leg.



19 and 20.—Swing a light club well back and up to the right. Let your ɦt shoulder and trunk go with it, bringing the body's weight on to the ɦt foot. Then swing outwards and down and well away to the left, ɦich brings the weight on to the left foot. Do a similar drive left-handed.

FIG. 21.—Lift the arms, with the palms facing forward, to the level of the shoulders, as you rise on your toes and the balls of your feet, and breathe in. Then let your arms down as you let your breath out.

ɪ22.—Send the arms, with the palms wnwards and thumbs touching, straight front of you but upwards, so that the gers are above the level of your head.

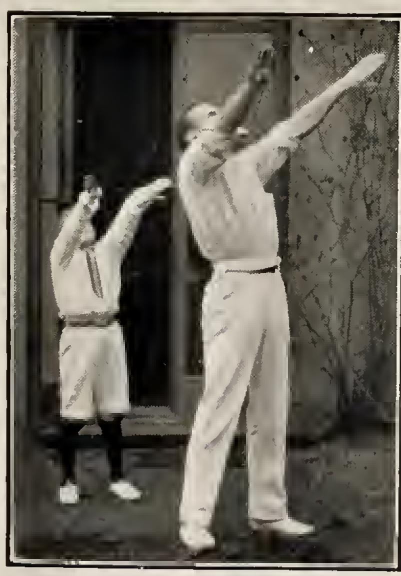


FIG. 23.—Bring the backs of the hands together. Then sweep round and out till the hands come about on a line with the shoulders. Keep the fingers well together.

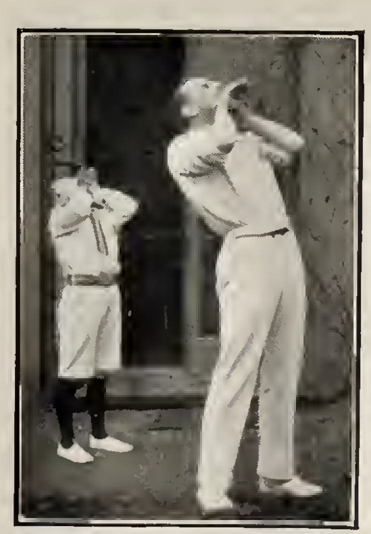
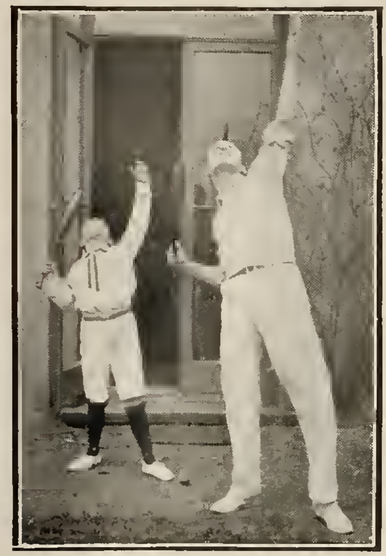


FIG. 24.—Draw your hands up, thumbs together, and with their backs against your chin. You are then ready for the first action again, as in Fig. 22.

FIG. 25.—Assume a boxing attitude and prepare to lunge.

FIG. 26.—As you lunge, shoot out the left hand with a good blow that brings the shoulder forward to add force. Recover your poise and lunge again. Then do this with the sides reversed.



27.—Holding an imaginary ball in your left hand, bend the ole trunk and the head far backwards to the right. At the ne time send the right shoulder, elbow, and hand far backwards l downwards. Then throw the imaginary ball straight up.

FIG. 28.—Looking up, bring your right hand and arm up to their full extent, and then down across the body, your trunk moving with it, till your right hand and side end up as illustrated. Do this with the left side also.

FIG. 29.—Stretch your head and arms up as far as they will go without strain, keeping the palms upwards.

FIG. 30.—Then stretch down your limbs as far as they will go. Do not hurry the movement.

COURSE OF EXERCISES FOR BUSY PEOPLE *(concluded)*

CHAPTER XCIV

VARIOUS FORMS OF EXERCISE (*concluded*)

Training—Professionalism—The Gymnasium—Games and Sports—Cricket—Football—Golf—Croquet—Running and Jumping—Lawn Tennis, Tennis, and Fives—Hockey and Shinty—Skating—Dancing, etc.—Riding—Swimming—Cycling—Hammer-throwing—Singing.

TRAINING

So many games and sports require a course of careful training, should excellence be hoped for or desired, that it is well to consider what training means. It may be described as a gradual process whereby the heart and circulation, the respiratory organs and the muscles of the body, are made fit to accomplish some desired effort, be it a walking, jumping, or running match, a game of tennis, a rifle competition, or any one of the many sports and pastimes with which we in this country are acquainted. The organs and muscles of the body must be brought equally and together into a state of correlative fitness. The development of the muscles of the lower or the upper limbs, or of both, without a corresponding increase in the heart's strength, is not training, for failure will result unless all are harmoniously and proportionately fitted for the prospective effort. One appreciates that one is out of training when a short run is attempted or a stair is hurriedly mounted ; the muscles may be equal to the occasion, but the heart is thrown out of gear, as evidenced by a fluttering sensation over that organ, or by getting out of breath. By training this condition is overcome. The heart muscle can be developed as markedly as the muscles of the arm or of any part of the body. When the meaning of being out of training is fully grasped there is more likelihood of training being undertaken in a rational spirit than it is at present, and with better chances of success. The will can make the muscles of the limbs perform more work than the heart can respond to,

for the heart is not under the influence of the will, as are the voluntary muscles.

It is plain in the first place, therefore, that training to be successful must be gradual. A young man undergoing rational training must begin by walking at a gradually increased pace day by day; afterwards running, at first slowly and then gradually increasing the pace as breathlessness gets less and the heart ceases to flutter, palpitates less violently, or becomes free from pain. If it is intended to run races this course of events must be continued against time, but if the exercise is being taken for the purpose of general fitness for games or sports other than running or jumping, such as cricket, rowing, tennis, or even shooting or hill climbing, reserve of heart strength will be obtainable by very smart walking and a very moderate rate of running.

Training should be Gradual.

Severe training, however, is a trying ordeal, and must be carefully watched. Previously to training, the heart must be examined by a physician; and during the process also at frequent intervals—every week at least—the physician must be consulted. The heart may develop satisfactorily as far as its actual muscle is concerned, but constitutional troubles of several kinds may develop insidiously without pain or warning. Reducing weight by sweating brought about by rapid walking or running whilst enveloped in a sweater is always dangerous. Training by sweating should be shunned by anyone having regard for his future health; it means an attempt at accomplishing the training in too short a space of time. Anyone undertaking an ordeal of the kind should begin not weeks, but several months beforehand, so that the fat in the abdomen is gradually lessened, and the heart and muscles are brought into a state in which the proper training can be commenced and gradually perfected.

Should be Carefully Watched

The methods of trainers are many: this one commends a diet in which meat predominates; another advocates so-called vegetarianism; a third has a belief in the power of sugar to give "wind"; and so forth. Now and again it is interesting, from the point of view of physiological investigation, that these various fads and fancies should be tried; but in the ordinary course of training the diet should consist of "ordinary" food taken in moderate quantity. A few simple rules suffice.

Methods.

Breakfast of eggs and bacon *or* (not *and*) fresh fish, with two or three

slices of toast and butter; a breakfast-cupful of weak China tea, with sugar and cream (not milk), drunk ten minutes after finishing eating; *or* oatmeal, barley meal, or wheat meal porridge, with milk, but nothing to follow.

Eleven o'clock.—Glass of milk and hot water (half and half) and a biscuit.

Luncheon.—Meat, hot (not cooked twice) or cold, with toast or pulled bread, and one vegetable; stewed fruit or jelly (not milk puddings). Sip a claret-glassful (half tumbler) of water (not aërated) during meal.

Tea.—Breakfast-cupful of weak tea and toast or pulled bread, butter, or jam.

Dinner as at luncheon.

Bedtime.—Cup of cocoa, one-third teaspoonful of cocoa to a breakfast-cupful of boiling water, with sugar and milk, or a glass of half hot milk and water and a biscuit.

Bed at 10.30 p.m., up at 6 a.m.; glass of milk and hot water; "bath-room" exercises or a walk for one hour at a quick pace, with an occasional run.

Bath: stand up in the bath, sponge all over quickly (two minutes) with hot water—temperature 100° F. to 105° F.; afterwards sponge head and neck with cold water, and rub down with a towel. Dress and have breakfast at 8 a.m.

A regimen of this kind is sufficient in its "severity" for anyone undergoing training, be the object what it may; if it is not sufficient, the training had better be given up, for anyone requiring a stricter regimen should never go into training.

The "severities" entailed are: no alcohol, tobacco, or coffee; no soup, no milk puddings after meat.

The dangers of training may be divided into three groups—those which may arise at the commencement of training, those which may occur during the course of training, and those which supervene during the training-off.

Dangers of Training.

Before going into strict training, or engaging in competitions for prizes in any active game, it is wise to get a physician's sanction. After the training has commenced there are several possible dangers to be feared; of these the commoner are such ailments as lumbago, sprains, chills owing to wearing insufficient or damp clothing after perspiring freely, and so forth. These may prove serious enough, but as a rule they are trivial. More serious in their effects

and consequences are rupture (hernia), injury to heart valves or heart muscle, and kidney troubles (Bright's disease).

Rupture.

Rupture, a severe strain in the groin, technically termed hernia, is caused by some part of the contents of the abdomen being forced through the walls of that cavity in the neighbourhood of the groin. It may come on insidiously, a small lump coming and going, but increasing in dimensions from day to day, or it may appear suddenly during severe exertion, such as lifting weights, rowing, or during a tug-of-war. The condition may become rapidly serious owing to the protruded part—usually the bowel—becoming strangulated, when operation to save life must be done at once; but the danger is more remote, as a rule, and "the lump in the groin," scarcely noticeable at first, attracts attention after, it may be, many months. When a hernia is discovered during training, the training must be given up at once, for the rupture will become worse with each day's endeavour. Once established, the hernia has to be kept from descending by wearing a truss, or an operation termed a "radical cure" is required.

Heart Troubles.

The heart and blood-vessels are submitted to great strain during severe training, and it is only the strong and healthy heart that can stand it. The heart may break down under the ordeal of training owing to a rupture of one of its valves, or to the muscular wall giving way under the pressure, the result being "dilated heart." Both of these are serious conditions, attended by consequences which may quickly prove fatal, and which in any case occasion permanent damage. They are caused by forcing the pace, making demands on the heart to which it is incapable of responding, but to which it might have been quite equal had the training been more gradually, slowly, and systematically conducted. The means of preventing these calamities are clearly indicated when the cause is appreciated.

Another frequent cause of breakdown, due to heart and blood-vessel changes, is manifested by what is technically termed albuminuria—in other words, albumen in the urine, a form of Bright's disease. It is chiefly for this reason that it is imperative to have the physician's advice at least once a week during severe training. The state of the heart and the condition of the urine are the chief means of estimating the physical state, and they must be pronounced upon by a doctor, for neither the feelings nor the appearance will indicate the early development of such troubles.

For a healthy man, getting into good condition by training is with ordinary care practically without danger ; but the trouble may arise after the " event " is over and training is given up. How it is given up makes or mars the future health of anyone who has gone through the ordeal of severe training. The early death of athletes is heard of all too frequently, and well-known athletes seldom reach a ripe age. The few who do so are noted and spoken of, and the advantages of athletics are heralded abroad.

Training-off.

The rule that the time taken in training-off should be equal to the time taken for the course of training is a salutary one to follow. If, after a high state of physical development acquired by a rigid course of training, exercise is suddenly and markedly curtailed, alcohol and tobacco are resumed, and a late hour of getting out of bed is encouraged, the economy gets thrown out of gear, the muscular fibres of the heart undergo degeneration in part, and in part diminish in bulk and power. Should the atrophy be allowed to proceed at a rapid rate, the heart-beats become irregular—now excessively slow, now quickened by the least exertion ; the breathing, the digestion, the liver, and the kidneys are all functionally awry, and the man who felt so fit a few weeks previously becomes depressed in spirits, irritable, dyspeptic, and disinclined to take exercise. Permanent damage may result, or a weak or irritable heart and circulation continue. All this may be prevented by taking exercise in gradually lessened amounts from day to day. If running has been the event trained for, then a shorter distance at a slower pace should be run with daily diminution for some weeks, or for a time equivalent to that spent in training.

This plan of training-off is not one likely to be followed. An amateur training for any particular event is generally very tired of the process, glad when the event is over, and only too thankful to think that he is now free to " do as he pleases " and to " slack." Sudden slacking is dangerous—gradual slacking is safe ; the former may cause chronic ill-health, the latter will at any rate leave one no worse than before the training commenced.

PROFESSIONALISM

In almost every game in Britain a certain number of men devote a succession of years or their whole life to it. Some are paid a weekly wage for their work and are termed professionals ; others to an almost

equal extent play continuously but receive no remuneration—amateurs. Both classes have come in for a good deal of adverse criticism. It is no doubt rather sad to think of men spending their days playing games ; but setting aside the influence on the individual, and regarding the effect of the work of these men as hygienic factors in the national life, a great deal may be said in the way of commendation. Other nations obtain for their young men by compulsory military training what we seek to gain by out-of-door games. Without these games we should suffer physically ; and without a goal of excellence and the stimulus to attain perfection derived from those who devote themselves wholly to games, our exercises would lack discipline, verve, and encouragement to take exercise for exercise' sake and for the idea of physical betterment.

Without professionalism our games and sports would be merely schoolboy games, and our young men would despise them as unworthy of their attention. With neither military training nor the discipline, physical and moral, necessary to attain efficiency in sport, our young men would deteriorate, and our national physique suffer. When, therefore, we see men devoting the best part of their lives to sport and games, however derogatory it may appear for the men in question, we must remember that they are potent factors in upholding the health of the people as a whole.

THE GYMNASIUM

The establishment of gymnasia in Britain is a thing of recent years compared with several other European countries. Out-of-door games in this country gave to our youths the measure of physical development required, and gained for the young Briton a superiority in field and manly sports which remains with him to this day. But as towns grew into cities, and the cities became of enormous size, so that open spaces for sports became more and more distant, and therefore more difficult to reach, gymnasia were instituted, and have greatly developed in size, appliances, and number within the past quarter of a century. Gymnasia are useful, but they fail to give what games and sports in the open air supply. The feats we see executed in our gymnasia are attractive to onlookers and to the pupils or performers, and at first sight would seem beneficial in the highest degree. That they do good is undoubted, but that they are attended by the greatest good is questionable. In the first place they are performed indoors, often in badly ventilated

rooms, and generally in the evenings. These drawbacks it is impossible wholly to remove, for the nature of our climate, the facts that open spaces in towns are not available and that men are occupied during the day in earning their livelihoods, combine to compel us to take our exercises in gymnasia. Several of the detrimental features of these institutions, however, can be relieved if not remedied. The ventilation of the premises should be the first consideration. Whenever possible, the gymnasium ought to have a movable roof, so that a semblance, at any rate, of exercise in the open air may be secured. The exercises themselves should resemble those practised in the open air—if not actually, at least as closely as possible. In out-of-door games and sports there are no rings, cross bars, "horses," parallel bars, etc., yet our gymnasia are furnished with all of these liberally. They are, no doubt, a necessity of a gymnasium, for without them it may be truly said there would be nothing to do. During recent years running in Indian file and drill exercises have been added, not without benefit.

Another drawback to gymnasium work is that drills, however hygienic, are apt to—and do—become monotonous; running in Indian file is not inspiriting, and were it not for some trick feats on the bars, etc., there would be little to encourage a young man to continue his exercise after he has reached a certain stage of proficiency. Gymnasia, necessary as they may be, can never supply the place of British games and sports —there is a lack of the spirit of the game as well as of that kind of discipline which games engender, and which has done more to form and establish the characteristics of British folk than any code of rules or any formula of behaviour.

Games and Sports

Britain has been for many years the home and centre of all that appertains to field sports and games; and British folk, wherever they go, carry the spirit and instinct of sport with them, be the climate of their new home torrid or temperate.

CRICKET

To take out-of-door exercise and to "play the game" are characteristics of the people of these islands, and give to our young men that curious blend of reserve, manliness, discipline, and sense of justice which renders them capable of leading and of ruling men in the high positions they are called upon to fill in many parts of the Empire. This

spirit is encouraged and developed by many of our national pastimes, and perhaps by cricket more than any other. In itself cricket is not a complete exercise. He who would be proficient must engage in exercises of other kinds, but rapid walking is by far the best. The professional cricketer, unless he is a bowler, does not get much real exercise during a three-day match. He may, with fair fortune, bat for an hour, and if his "side" is in he as a rule takes no more exercise for that day. Fielding is tiring in that there is so much standing; it is relieved by a leisurely walk at the end of an over, but this is insufficient to stimulate the heart. The occasional run after a ball compensates also somewhat, but unless systematic walking for one hour in the early morning at a rate of about 130 paces per minute be taken, with an occasional run, the professional cricketer is apt to get stale—a condition which is the fate of so many men, and accounts for otherwise inexplicable failure to make runs, to bowl well, or to catch. To make a long score at cricket means that the man is physically fit at the time. He may even, when stale, make twenty or thirty runs, but a "century" means physical fitness combined with skill.

An Incomplete Exercise.

Cricket, however, is a safe game; if the heart does not possess that reserve which is the meaning of being physically fit, it is not likely to be overtaxed, for when the heart muscle has reached the limit of its powers, the ball finds the batsman's wicket, or the bowler's deliveries are severely punished. Amateur or school cricket is a much more rapid game than when professionals play, owing largely to the men or boys being untrained. The heart beats rapidly, the heart muscle is more irritable, leading to wilder hitting and more work for the fielders. Amateur cricket is engaged in, as a rule, more spasmodically, and unless ample exercise is taken between games, the limit of reserve is soon reached, and so is the wicket.

A Safe Game.

The regimen during the cricket season should be:—

Get out of bed not later than 7 a.m.; take a glass of milk and hot water or fruit; walk for an hour at a rapid pace; on returning home sponge all over with hot water rapidly, then have a cold shower to head and shoulders.

Breakfast.—Moderate in quantity, especially as to amount of bread and tea or coffee. At 11 a.m., before commencing the game, a glass of milk and hot water and biscuit or fruit.

Lunch.—One course and one vegetable, with not more than a tumblerful of fluid sipped towards the end of the meal.

Tea.—One cup of freshly drawn China tea, and toast or pulled bread or biscuit.

Dinner.—Two courses, no milk puddings, no sweets.

In very hot weather the quantity of fluid during the game should be limited to moderate dimensions. After the game a rapid sponge with hot water will do good, but not a cold bath.

FOOTBALL

During the past quarter of a century football has grown in popularity. Previously we had football enthusiasts, but the public did not patronise the game, and "gate money" was infinitesimal. The prevailing outcry at present is not against football, but against looking on. All onlookers are classed together as prodigies of iniquity, and are accused of going to the football match to bet, to drink, to lounge; and there seems no name bad enough for them. These sweeping assertions are, as usual, untrue. Betting is not to any great extent a feature of football; the fact that the man or boy goes to the football field during a winter afternoon to see a match betokens that he prefers being in the open air rather than drinking in the public-house; there is little lounging, for the excitement of the game enlists his sympathy and active attention. Most of the onlookers have been, or are, players themselves, and they go to a match to see their friends play because they are interested in the men and the game. Were there but few onlookers, football would not be so popular—that is, there would be fewer clubs and players, and the fact that onlookers are many and enthusiasm is intense encourages our young men to take up football to an extent unheard of before "looking on" at the game was so common. There are drawbacks to almost every game when professionalism crops up, but in this case the good far outshines the evil.

Football is an arduous, quick, and exciting game, demanding a concentration of physical expenditure. The Saturday's football game represents the total muscular energy expended for the week as far as the game itself is concerned. It taxes the strength—that is, the reserve power of the heart—to its utmost limit and frequently beyond it. The man with the heart muscle in best trim will last the longer; the man who is out of training soon falls away in his game. The preparation

for the weekly game must, if efficiency is desired, be continuous, strenuous, and rational. During the week rapid walking and running are essential. An hour's exercise daily must be taken, when the first half-hour should consist of walking at as rapid a pace as possible; the third quarter of the hour should be spent in running at a gradually increased pace, and the last quarter of the hour should be devoted to walking as rapidly as possible. The best time for the walk is the early morning, before breakfast if possible; evening exercise in winter has to be taken in the dark, and after the fatigue of the day's work. The gymnasium may afford a training of sorts fitting for football, but it is not satisfactory.

Training for the Weekly Game.

The football player who, instead of taking systematic exercise during the week, looks to the game alone to keep him fit, will not only be an indifferent player, but runs considerable risk of doing damage to the heart valves or muscle, or to the blood-vessels, by suddenly—that is, whilst untrained—putting forth the supreme efforts at times demanded of him. In all forms of exercise, violent and spasmodic exercise when the man is "out of condition" is most dangerous, and should never be undertaken. Dilatation of the right side of the heart is almost certain to occur, with its life-long train of deleterious consequences. This condition of heart is liable to ensue even when the man is in training, but in a heart unprepared for the strain there is a tenfold liability to its occurrence.

Advantages of Football.

The advantages of football are these: (1) The game can be played in a short space of time, so different from the long hours or days required to finish a cricket match; it is therefore possible for a much larger number of our young men to engage in football than in cricket. Cricket is possible only for students or schoolboys, for professionals, or for men having leisure and money to devote to the game. Football, on the other hand, is open to any man having a half-holiday during the week. (2) Football is a winter game, and therefore to be encouraged, as there is so little to be done in the way of out-of-door games or exercises during winter months. (3) Change of clothing after the game is over is rendered necessary by the fact that the ordinary clothing is laid aside and a football kit assumed, which must be changed for the former when the game is over, thus avoiding to a great extent the chances of chill.

Radiograph: W. A. Coldwell, Mandeville Place, W.

FRACTURE OF THE HUMERUS SUSTAINED IN FOOTBALL.

As disadvantages it is unnecessary to do more than refer to the occurrence of fractured bones, strains, and dislocations in the football field, and to the development of pneumonia from chill following on violent perspiration in cold, wintry weather.

GOLF

As a means of encouraging walking exercise, golf is of the first importance. The golfer has an object in his or her walk, and the monotony of the constitutional is thereby relieved. As the game must be played in the open air and away from the atmosphere of the city, it does a double good. It requires, moreover, no special training preliminaries, for there is no heart strain likely to cause a breakdown even to the beginner. The walk it engenders may not be quite fast enough to yield the highest good obtainable from quick walking, but that is a matter of habit, not a fault in the game. Other things being equal, the man who can walk best—that is, who has his heart muscle strengthened a little beyond ordinary requirements so that he possesses a reserve of strength—will make the best golfer; for cardiac flurry or muscular tremor, the result of want of muscular tone and reserve, will make him miss his "put" on the green in a manner which he or the onlooker regards as incomprehensible. The miss may be due to other causes, digestive or mental, but the commonest cause is that the heart and circulation are "below par."

To excel at golf, as at other games, moderation in eating, drinking, and smoking is essential, and as everyone plays in competition with a companion or against "bogey," the spirit of rivalry is always present, which from the point of view of personal hygiene is beneficial. Golf has come to us as an immense physical boon. It is the greatest health-giving factor introduced in our time. It is suitable to men of all ages, but especially is it beneficial to the middle-aged and even to old men, whom it brings from that seductive paralyser of activity and heart weakener, the armchair.

Golf has come to stay; it is not a mere fashion for a day, but is for all time. The waste places of Britain are being converted into sanatoria in the best sense of the word, for it is not the ailing who are being treated there, but the national health is being bettered and national vigour improved on the golf greens and courses of our countryside.

CROQUET

Although at one time widely played, croquet fell out of fashion, but during recent years the game has been revived. The modern game is considered to be an advance upon that practised during the decade 1860-70, and has many followers. As an exercise croquet is defective ; it brings men and women into the open air, and calls for a certain amount of walking, but the drawback to the game is the amount of standing involved whilst others are playing. The game is fatiguing without causing healthy tiredness. When ladies play there should be a plentiful supply of seats around the lawn, and between the strokes the players ought to sit down as often as possible.

RUNNING AND JUMPING

Except in the case of a small number of professionals, games and sports in which running and jumping, or both, are concerned, such as sprinting, long-distance running, harriers, hurdles, are mere episodes in the life of schoolboys or youths. The "event" has to be trained or prepared for in some fashion ; success cannot be otherwise obtained. Running powers gradually diminish from childhood upwards. The child naturally runs in preference to walking ; youths run, for the most part, in races or at games; older men only run at odd times, when necessity compels. One can gauge fairly well the age of a man when regarded from the physical standpoint, as distinct from the actual number of his years, by the way he runs. If he runs on his toes—that is, with the heels off the ground—then is the elasticity of youth still with him. Most men over thirty when running plant the whole foot on the ground. That is not running—it is mere "hastening," for in running both feet are off the ground for a period. Running is not an exercise ; it is a sport—that is, it is not practised unless by way of training for some game or event. The rules laid down for training have to be carefully studied by one intending to run races.

Jumping also is a sport and not an exercise, and is of little value from the point of the national physique. There seems little doubt that greater heights in jumping competitions have been attained during recent years than at any time of recorded history. Training is no doubt accountable for this, and perhaps an actual change in the frame and development of the men of to-day.

LAWN-TENNIS, TENNIS, FIVES

Excellent games all of these, and possessing much in common as regards methods. The two last-named are more strenuous, and test the strength of heart and muscle to a marked degree.

Few men or women are physically unfit for a game of lawn-tennis, but many overtax their strength by playing too many sets, or competing with greatly superior players. When the players are of fairly level attainments, men matched against men, women against women, and the game is played for not longer than one hour daily (with a five-minutes' rest at half time), lawn-tennis is an excellent game. If it is played for more than one hour a day, the times should be separated by a long interval, say one game in the forenoon, another in the afternoon. The "tennis party" is not without danger, especially to girls. Set after set may be played, an occasional rest taken, followed by playing and rest, repeated several times, until the girl is wearied and overtaxed. Lawn-tennis is no exception to the rule that women should never play in matches; but they do, and they "seem" none the worse for it; but the physician and the birth statistics tell a different story.

The Tennis Shoe.

The tennis shoe without heels is not quite hygienic; a shoe without a heel strains the calves of the legs; it is the cause of rupture of the tendo-Achillis at the back of the ankle, which one hears of as a frequent accident in our games and sports. Going barefoot has not the effect of tiring the calves; the level of the foot is not affected in the same way as when a shoe without a heel is worn.

HOCKEY AND SHINTY

These games consist of running or sprinting at a great rate for short distances at frequent intervals. The ball and the club are mere accompaniments in the game. Hockey and shinty possess the advantage of being half-holiday games, and therefore useful to the majority of the community. Young people only should join in them, for untrained men of thirty and over can only at risk to the blood-vessels and heart take part in a game requiring sudden sprinting at a great pace. The "hockey" girl has become a feature of our playing fields; it is too early to pronounce upon the effect this departure will have upon the racial problem as regards population; but so far the indications are against hockey for girls. When girls do play it should be against girls,

and not against boys. For married women hockey should be forbidden ; the birth statistics are low enough without hockey.

SKATING

In England and Ireland we get on an average no more than about one day's skating in a year ; it is, therefore, as a national pastime so infinitesimally small a factor as to be unworthy of consideration in the laboratory of national health. Considered, however, as a beneficial form of exercise, skating stands high in the scale. Skating on artificial ice is usually practised in an atmosphere so deleterious that little can be said in its favour.

DANCING, SKIPPING, HOP-SCOTCH

As an exercise, step-dancing has no superior ; it exercises the muscles of the lower limbs and loins, providing a stimulus to the circulation, promoting the action of the skin, and if practised in the open air or by a widely opened window is highly beneficial. Step-dancing has the advantages that it can be done by the individual without companions, and can therefore be carried out at any time convenient, and that it provides an indoor amusement and complete exercise in wet weather. Dancing-party dancing is, as a rule, quite unhygienic ; it is usually begun at a time of night when people ought to be going to bed ; the crowd in the room renders the air deleterious to health, and the kinds of food and drink supplied at the supper table are unwholesome. The dances themselves are not calculated to benefit the physique ; compared with step-dancing, they are lacking as health factors, and must be looked upon as a social pastime and not as an element in the promotion of physical efficiency. In all our schools children should be taught step-dancing ; it is more efficient as an exercise than "drill," it is more enjoyable than any form of gymnastic exercise, and gives more pleasure than perhaps any playground game ever devised. Step-dancing ought to be compulsory in all schools. Skipping, if rather a senseless and aimless form of exercise, is physically beneficial. Hop-scotch and allied games are pleasant variations in exercise, and, as they develop the thighs and loins, are quite hygienic.

RIDING

Horseback exercise for men is salutary ; for women its benefits are doubtful. Every boy and girl should learn to ride, but for a woman after puberty riding exercise has many drawbacks.

Riding is not a complete exercise ; the muscles of the legs (as distinct from those of the thighs) of men who ride much and walk little dwindle in size, and the power of walking is accordingly reduced. The man who cannot walk well, we must repeat, is not physically efficient ; yet for men advancing in years there is no better exercise than riding, nor, provided walking is not neglected, for younger men either. The good effected by riding is attributable mostly to the succussions which follow each other in rapid and infinite numbers, owing to the step of the horse. The organs of the abdomen, and those of the circulation and respiration, are stimulated and benefited ; the mind is diverted for the time being from the ordinary routine of duty or work, and a general tonic influence is assignable to the pleasures of riding. The dangers of riding are for the most part connected with the soundness or otherwise of the horse ridden, although minor ailments, such as rider's cramp or strain, are attributable to the act of riding itself.

SWIMMING

Everyone should learn to swim ; but, the art having been acquired, the less seldom swimming is practised perhaps the better for the health of the individual. A prolonged stay in the bath, river, or sea is deleterious ; for swimming is attended with so great a loss of heat, owing to the water being so much below the temperature of the body, that a great deal of strength is rapidly lost. The art of swimming is well nigh a perfect exercise, although it is impossible, as a rule, to continue swimming for more than a few minutes except when the swimmer is an expert. The devoted swimmer, moreover, all too frequently becomes anæmic—the heart becomes disturbed, the breathing distressed, albumen may be present in the urine, and a listless or irritable demeanour indicates something wrong. In summer, boys, if allowed to do so, will spend a whole day on the banks of the river, now in the water, now on the bank. The loss of heat to the body is enormous, and the consequence, if the weather unfortunately for them should keep warm and fine, is heart and kidney troubles of a serious nature.

Diving is an art of but little practical use, and as practised in swimming baths, under conditions which are wholly artificial, is attended with considerable danger where it is performed. Diving is a pleasurable relief from the monotony of the swim in the swimming bath ; but it is practically a pastime rather than a useful accomplishment, for, except

in the swimming bath, to have to dive into a few feet of water from a great height is well nigh unheard of.

ROWING

Rowing races, and an occasional " day on the river," are the forms in which the majority of people, other than seafaring folk, engage in rowing. The former is a sport, the latter is a pastime or mere outing. Neither form is a complete exercise, as it is only practised at intervals and on special occasions.

For men or women going " out for a row " there is need for a word of caution. A middle-aged man, unaccustomed to rowing except at long intervals, and untrained, runs considerable risk of doing permanent damage to his heart by suddenly starting to row strenuously. Being unused to the exercise, he is apt to put all his strength into it ; he holds his breath as he pulls the oar through the water and strains to the full. Holding the breath means that the diaphragm is fixed, the chest made rigid, and the heart strained so that the heart muscle is in danger of dilating or the valves of rupturing. Rupture in the groin also may be induced, and several other major ailments, as well as some minor ones, may ensue.

For the untrained occasional oarsman the rules should be : To commence at a very slow stroke ; to allow the breath to escape whilst the oar is being pulled through the water—that is, when the effort is being made ; never to strain to pass or race another boat ; to refuse to pull, except with sufficient help, a heavily laden boat against a current. To row after a heavy meal or liberal drinking of aërated waters is especially to be avoided.

Training for rowing races is a severe ordeal, requiring medical inspection before the training is commenced, at frequent intervals during the process, and immediately before the race is rowed. Were young men at our Universities more carefully watched during the rowing season, there would be fewer breakdowns and calamities to relate. The hard arm muscles may be obtained at the expense of a dilated heart or of kidney troubles of a serious or fatal character.

CYCLING

The advent of the bicycle brought in a wholly new form of exercise and of travel. As usual with new things, the cycle took some time to

get into favour with the community, but gradually it fascinated all classes of society, became a "fashion," and then to a great extent went out of fashion. At the present time the bicycle, the tricycle, and the motor cycle have fallen into their proper places as means of travelling at a rapid rate, and bicycling has ceased to be a mere fashionable pastime.

From the point of view of the national health, there are many advantages to be ascribed to cycling ; these are obvious to all. There are, however, several drawbacks which require to be considered and described. After the initial stages necessary to acquire the art of riding a cycle are over, the expert rider is able to travel great distances at a quick rate ; he may cover 50 to 70 or even 100 miles in a day. There is no breathlessness or flushed face as the result of this prolonged exertion, but instead some pallor and drawn features, with inability to eat or sleep properly. These conditions indicate heart strain. The movement of the lower limbs in long journeys becomes more or less mechanical, and the nature of the propulsion does not cause an increase in breathing proportionate to the hastened pulse. The consequence is that the blood is imperfectly aërated, and the right side of the heart becomes dilated. No ordinary man is ever again "the same man as he was" who has done 100 miles a day on a bicycle. Especially are these dangers apparent in young people. The whole of the boy cyclists in the French army were recently rejected for admission into the ranks as soldiers owing to heart disease incurred from their cycling. In the German army practically the same thing occurred. Boys and girls under fifteen years of age should never be allowed to cycle by themselves ; an older person should be with them to prevent them from overtaxing their strength. Riding up steep hills is the chief cause of heart trouble in cycling. The wise person will get off, but the youth thinks it derogatory to walk up hills, and his "elastic" blood-vessels and heart are readily dilated; they may recover, but they may not do so, and if the ordeal is continued permanent dilatation ensues.

A bicycle is an excellent thing to use on a "walking" tour. Short rides of 10 or 20 miles at a moderate pace, and when steep hills are avoided, are an excellent exercise for both men and women, and when a man is in fair training 40 or 50 miles a day may be accomplished without detriment.

Tricycles are largely used by business houses—drapers, butchers, bakers, etc.—as a convenient method of distributing their goods. The

tricycle is, without any extra weight, a heavy machine to drive ; but when it is laden with a large box in which the goods are taken about, it becomes a herculean and toilsome task to propel it. Little wonder, therefore, that the lads who ride these machines suffer from heart strain. It is a form of carriage which should be made illegal for growing boys.

Motor cycling affords rapid means of transit with but a very slight degree of exertion. The throb of the machine, however, is a drawback, and in some cases it appears to have induced impotence.

HAMMER-THROWING, PUTTING THE SHOT, TOSSING THE CABER

All of these games afford excellent opportunities of exhibiting strength. They are feats which require natural strength as distinct from gymnasium-produced or acquired muscular power. The men who excel in these games are endowed with magnificent loins and thighs, for it is there, as we have said, that natural strength lies ; and the legs and upper limbs of athletes who engage in these feats are not in any way markedly developed. As exercises they are incomplete and defective ; as tests of real strength they are supreme.

SINGING

Singing can only be admitted into the category of exercises when it is carried out in accordance with the rules of breathing and chest development laid down by expert teachers. However pleasant singing may be to the individual who practises it, it is only of hygienic advantage to the community when looked upon as one of the means of promoting physical efficiency.

CHAPTER XCV

PUBLIC HEALTH: THE GERM THEORY—THE CHANNELS OF INFECTION

THE GERM THEORY: Leeuwenhoek and what He Saw with His Microscope—Pasteur's Work—Lord Lister and Antiseptics—Further Discoveries—Main Factors in the Production of Disease—Influences that Lower Resisting Power. CHANNELS OF INFECTION: Personal Contact—Premises and Materials—Water Supply—Food.

THE GERM THEORY

Pioneers.

It was a linendraper of Delft, in Holland, named Antony von Leeuwenhoek, who in 1632 first demonstrated the existence of microbes. With very primitive instruments he pursued science with enthusiasm, and in the long evenings after his days' work he amused himself by learning the art of grinding lenses, and so was able ultimately to invent a microscope. Through this microscope he saw living things in water and other fluids. He believed these moving animalcula to be an accidental pollution, and it was not until the middle of the following century that Plenciz, of Vienna, first conceived the idea that these tiny forms of life were distributed almost universally in Nature, and were probably the cause of decomposition. One hundred years more passed by before the genius of Louis Pasteur, the great French chemist, and Spallanzani, an Italian, and John Tyndall, an Englishman, threw a flood of new light on the mighty part played by microbes. It was they who first showed that these germs, though so small that they are invisible to the naked eye, were the prime factors in producing fermentation, putrefaction, and even disease. "Without organisms," said Pasteur, "there is no fermentation; and to every fermentation there is a particular organism." From Pasteur's researches into the question of fermentation there has come very much. Indeed, it is not too much to say that it led to a new science.

For it is correct to say that Pasteur's work first opened the eyes of scientific men to the importance of the study of bacteria. It was found that as agents of fermentation they play a considerable part in the affairs of men. They ripen cream and flavour butter. They purify sewage and remove waste organic products from the land. They are the active agents in a dozen industrial fermentations. Three simple illustrations will suffice to show the far-reaching effects of the work which even Pasteur himself built upon his studies of fermentation. Having demonstrated the process of fermentation as set up by beer-yeast, he turned his attention to milk, and in particular sour milk. Under the microscope he discovered the tiny cells which set up lactic fermentation, or, in other words, turn the milk sour. These he isolated, and added infinitesimal quantities to fresh milk, which thereupon also became sour. It is not warm weather, and it is not thunder, that turns milk sour. It is a germ in the milk. Lord Lister followed up these researches and showed that milk had no "inherent tendency to undergo lactic acid fermentation." Milk in the healthy udder of the cow contains no germs of any description. If it be drawn from the udder into absolutely clean flasks which are there and then sealed, the milk may be kept for an indefinite time without clotting or turning sour. It seems a very simple discovery. It consists of only two elementary facts: first, living organisms are the cause of sour milk; and secondly, these organisms obtain access to the milk from outside sources. That is all. Yet that one piece of work, crystallised into legislation, has entered into the statute book of every civilised nation, and is the basis of the control of the millions of gallons of milk coming into London or New York every year. What the protection of the milk-supply means in terms of health it would be difficult to over-estimate. The ramifications of the trade are now so numerous and complex, and milk enters so largely into the diet of children, that anything which affects it affects a staple article of food. When Pasteur laid the foundations of our knowledge of sour milk, he introduced the elements of bacteriology into the practice of the farmyard, the dairy, and the kitchen. Out of that work also grew the public health legislation in respect to the milk supply, now in force, and which is without doubt saving thousands of lives every year.

Pasteur's Work.

Then, again, in his silkworm investigation Pasteur applied the know-

PASTEUR IN HIS LABORATORY.
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ledge gained by his work on fermentation. In 1853 the whole French silk industry was threatened with disaster owing to the existence of *pébrine* and *flacherie*, which destroyed millions of pounds' worth of cocoons. Pasteur not only discovered the cause of these two "diseases," but also introduced a method of prevention which brought the industry back to prosperity. When it is remembered that France holds two-fifths of the world's trade production of silk, valued at many millions per annum, it will be seen how great were the financial and economic issues involved. But this was not all. For these particular researches exerted an influence on the application of science to industry, and they advanced also the technique of the science of bacteriology.

Lord Lister and Antiseptics.

And thirdly, there is the most wonderful application of all in the antiseptic treatment of putrefaction associated with the name of Lord Lister, of whose researches something has been said in the Introduction to this work. When, in 1861, Mr. Lister was appointed surgeon at the General Hospital at Glasgow, he had an opportunity for the practical study of putrefaction in wounds. Speaking at the Dublin meeting of the British Medical Association in 1867, he explained the position at which he had then arrived in the following words:—

"In the course of an extended investigation into the nature of inflammation and the healthy and morbid conditions of the blood in relation to it, I arrived several years ago at the conclusion that the essential cause of suppuration in wounds is decomposition brought about by the atmosphere upon blood or serum retained within them, and in the case of contused wounds upon portions of the tissue destroyed by the violence of the injury. To prevent the occurrence of suppuration, with all its attendant risks, was an object manifestly desirable, but till lately apparently unattainable, since it seemed hopeless to exclude the oxygen which was universally regarded as the agent by which putrefaction was effected. But when it had been shown by the researches of Pasteur that the septic properties of the atmosphere depended not on oxygen or any gaseous constituent, but on minute organisms suspended in it, which owed their energy to their vitality, it occurred to me that decomposition in the injured part might be avoided without excluding air by applying as a dressing some material capable of destroying the life of the floating particles."

This is the basis of Listerian surgery, and it is a basis founded upon the work of Pasteur. The manner of its application has changed, but

the principles remain the same. Every surgical operation, minor or major, is in these days performed under the antiseptic or aseptic system. Now that the time has come when all men avail themselves of it, and it alone saves innumerable lives every year, let us not forget who laid the foundations. In 1874, in a letter to Pasteur, Mr. Lister wrote: "Allow me to take this opportunity to tender you my most cordial thanks for having by your brilliant researches demonstrated to me the truth of the germ theory of putrefaction, and thus furnished me with the principle upon which alone the antiseptic system can be carried out. Should you at any time visit Edinburgh, it would, I believe, give you sincere gratification to see at our hospital how largely mankind is being benefited by your labours."

Forty years' experience of antiseptic surgery has considerably improved the methods adopted, and to-day it is practised throughout the world. Little wonder that, in 1892, Sir Joseph Lister said of Pasteur that he it was who had "raised the veil which for centuries has covered infectious diseases," to the incalculable benefit of the human race.

These are but three illustrations of the far-reaching influence of Pasteur's work on fermentation. But they alone more than justify the noble words spoken of him—

> "Who wageth still with death triumphant strife,
> Who sowed the good that centuries shall reap."

Further Discoveries.

Pasteur's work, however, was by no means the final step in the new knowledge of germ life. Quickly following him came Davaine, Pollender, and others, who found these germs in the blood and tissues of animals suffering from or killed by certain diseases. It was also found that if such germs gained access to the blood of other animals the same diseases were set up. The wonderful history of the growth of our knowledge of these minute forms of life and the enormous part they play in human life and death has been shortly summarised by saying that in the seventeenth century these living organisms were first *seen*; in the eighteenth century they were found to be the *cause of fermentation*; and in the nineteenth it was discovered that they were *the producers of disease.*

Now the production of disease depends on two main factors. First, there is the body of the person attacked by the disease; secondly, there is the agent or germ of the disease, which is the attacking party. The

first is the *soil*, the second is the *seed*. To produce disease both are necessary. To obtain a harvest the farmer first prepares the land, then he sows the seed. In the act of sowing, some seed falls by the wayside, or on stony ground, or in unsuitable soil, and the result, however good and vital be the seed, is nothing. But when the seed falls into good ground—that is, susceptible, responsive soil—*and there are a suitable temperature and sufficient moisture*, the seed sprouts and produces blade and ear and corn. We all know this simple yet wonderful and mysterious process, but we forget how universal is the same law of production. Disease also is produced in this way. The soil, which is the body, must be susceptible to disease, and there must be in the body that temperature and moisture which are favourable to the growth and increase of the germs of disease. The ordinary body temperature and the ordinary moisture of the tissues *are* favourable, but happily the healthy tissues of the human body resist disease, and as a rule the healthy blood is no friend to intruding bacteria. For in the healthy blood and tissues there are various protective substances. On the other hand, the body which is depressed in vitality or injured from previous disease or accident falls a ready prey to the invading hosts if an individual comes in the way of infection.

Main Factors in Production of Disease.

What are the influences which lower the vitality and resisting power of the human body, and lay it open to the attack of these unseen foes? They are four in number, and may be expressed as follows:—

Influences that Lower Resisting Power.

1. Heredity and predisposition.
2. Bad ante-natal conditions.
3. Antecedent disease.
4. Evil conditions of environment and personal habit.

We know that few—if any—persons have perfect health. Many children are born with a bad hereditary history—born, for example, in a family addicted to drunkenness or liable to consumption, and on that account they start in life handicapped. Again, others are born with the poison of disease actually in them, a disease passing direct from parent to child; others, again, have a predisposition to certain diseases. Then ante-natal conditions may be bad, and before the child is born the mother may suffer from debility, illness, or even semi-starvation, and thus the child comes into the world debilitated and so badly under-nourished as to become very readily the victim of disease. Ante-

cedent disease also produces a favourable nidus for more disease. Measles in childhood, for instance, is often followed by pneumonia—which is the cause of most of the deaths in cases of measles—or later on by tuberculosis. Sore throat predisposes to diphtheria. Then we must not forget the general environment and surroundings of the child immediately after birth and perhaps throughout its life. Exposure to cold, bad housing, infected water supplies, insanitary workshops, and dirty homes all play a part in diminishing vitality and preparing the human body for diseases. Lastly, there are the habits of the people. Eating too much, eating too often, drinking too much and too often, insufficiency of sleep, uncleanliness, evil habits and excesses, all leave behind them their mark and make broad the way for any agents for disease.

THE CHANNELS OF INFECTION

When a person is attacked by disease germs and is unable to resist the attack, we say that he becomes *infected* with such and such a disease. Having seen that disease depends upon the germ and upon the human body, we must next consider *how* the germ gets at the human body. There are, of course, some diseases which are not due to germs at all, but to other conditions, such as undue exposure to cold or heat, over-fatigue, strains, and the over-burdening or wearing out of different parts of the body. But the fact remains that most of the infectious diseases are caused by germs, and it is with these that we are chiefly concerned. How do the germs of these diseases reach the human body? Speaking in a general way, and passing over heredity as a comparatively rare direct channel of infection, we may say that there are four chief ways in which infection is brought about.

Personal Contact.

First, there is personal contact. An infected person is generally, though not always, infectious or contagious. That is to say, the disease passes from him to healthy, susceptible persons with whom he comes into contact. Let us think of how this infectiousness works. Take small-pox. That is a disease which affects the skin and covers it with a rash that becomes pustular and eventually scabby. To touch that skin is to touch poison. We may touch with the finger many poisons without being poisoned, but if the skin of the finger is "chapped" or wounded, or in any degree has its surface abraded or injured, we may readily get a poisoned finger. Handling a small-pox patient takes something of the same character. The

breath, too, in small-pox may carry the infection, as it may also in measles, whooping-cough, pneumonia, and perhaps in scarlet fever. Then, in addition to contagion and by the breath, infection may pass in excretions (bowel excreta and urine in typhoid fever), secretions (saliva in "hydrophobia" or rabies), discharges (in syphilis and diphtheria), exhalations (in typhus fever), and expectoration (as in consumption). All these, then, are the ways by which infection may pass from the diseased to the healthy, both directly (as in a children's party or in an omnibus or in church) and indirectly (as when articles are polluted by infected discharges). Personal contact is probably the common line of infection in small-pox, measles, scarlet fever, and diphtheria. We cannot say precisely when the moment of poisoning is, nor can we say why some who come within the sphere of infection escape whilst others "catch" the disease. It may be owing to a differing degree of contact, or to some personal quality of resistance or susceptibility.

Premises and Materials.

Secondly, there are premises and materials. A house becomes infected with tuberculosis owing to the dust therein being contaminated with dried sputum from a consumptive patient. It has been shown by Dr. Coates, in Manchester, that in 66 per cent. of dirty houses examined in which consumptives had lived, virulent tubercle bacilli were present in the dust, and even in clean houses of consumptives the bacilli were found in 50 per cent. where the patient had been careless in regard to his expectoration. In Berlin Dr. Cornet found that 71 per cent. of the houses of consumptives retained infection, and Sir George Newman discovered in Finsbury, one of the central divisions of London, that 30 per cent. of the cases of consumption in that district occurred in houses where there had been one or more previous cases of the disease within ten years. It is this infection of the house which makes it true to say that the dirty, dark, overcrowded homes of the very poor are "the breeding places" of tuberculosis. Some kinds of workshops, and particularly public-houses, where there is much spitting, are likewise very widely infected with tubercle germs. But not alone houses. Implements, household crockery, bed-clothes, wearing apparel, carpets, curtains, books, bell-ropes, telephones, cabs, carriages, steamboats, and anything and everything which highly infected patients have used, may become infected, and so carry on the disease. We all run risks every day of coming into contact with something which is infected. We escape, as a rule,

because the contact is very brief, and our own bodies are healthy and resistant.

Thirdly, there is the water supply. Typhoid fever is perhaps the best example of a water-borne disease, by infected excreta gaining access to the water supply. Terrible disasters of this kind are on record. Everyone will remember the outbreak at Maidstone and more recently at Lincoln. In America, in some European countries, and in the East this source of infection is more common than in Great Britain, where the water supplies are now so largely under public control. Still, outbreaks do occur from time to time, and it must not be forgotten that water may readily become polluted from domestic uncleanliness, and carry infection in that way.

Water Supply.

Lastly, there is food. Meat, milk, ice-cream, shellfish, cheese, watercress, and other common articles of diet not unfrequently are the channels of infection in disease. Various forms of poisoning (including what is called ptomaine poisoning) result from eating diseased, unclean, or decomposing meat foods, such as unwholesome pork pies or infected sausages.

Food.

Milk, too, has been shown by many investigators to be a somewhat common channel of infection. There have been recorded some 200 epidemics of typhoid fever as due to infected milk, more than seventy epidemics of scarlet fever, more than forty of diphtheria, and a considerable number of sore-throat outbreaks. Milk infection follows the milk cart—that is to say, the incidence of milk-borne disease falls on those who have drunk milk. Thus milk-borne disease goes, we find, to certain streets on a milk round, to particular houses, and attacks women and children more than men. Fortunately, infectious disease spread by milk is usually mild, and there is a comparatively low mortality. Milk may become infected or polluted with dust carrying some degree of contamination, at the farm, or on the railway, or in the milkshop, or in the home of the consumer. It is a fluid which readily absorbs dust and dirt, and it is favourable to the rapid increase of germ life. This is why dirty cows, dirty cowsheds, dirty milkmen, and dirty milk cans should be avoided. Milk in the home also should be carefully protected from dirt and infection. Ice-cream, too, has on many occasions produced sickness and disease, particularly in children.

Shellfish—especially oysters—have been shown to convey typhoid fever and epidemic diarrhœa. They may become contaminated by

being fattened at or near sewage outfalls, or by being kept or prepared under unclean conditions. In 1902 serious outbreaks of typhoid fever occurred at Winchester and Southampton as a result of eating infected oysters at the mayoral banquets of those towns, and as many as 117 persons were poisoned on the same day in those two towns from oysters which had been fattened on a sewage polluted oyster bed. Cockles and other shellfish have also very frequently been found guilty of spreading disease.

Cheese is an article of diet which is not only indigestible to some persons but has been shown also to cause poisoning of a specific character, due in all probability to a ptomaine produced by bacteria in the cheese.

CHAPTER XCVI

PUBLIC HEALTH (*continued*): SIGNS AND SYMPTOMS OF INFECTIOUS DISEASE

Small-pox—Chicken-pox—Measles and German Measles—Scarlet Fever—Diphtheria—Typhoid Fever—Typhus Fever—Mumps—Whooping-cough—Epidemic Diarrhœa—Tuberculosis.

THE common infectious diseases have been dealt with in Part I. of this work, but it will be desirable here, in order to give some measure of completeness to the treatment of our present subject, briefly to summarise their chief signs and symptoms. The course of such illnesses is usually recorded in four periods: first, there is the moment of *infection*, when the infective agent gains access to the body of the individual who is attacked; secondly, the period of *incubation*, during which the agent is hatching or incubating, multiplying itself, and secreting its toxins; thirdly, the period of *invasion*, when the virus is manifesting itself in the body and producing the specific symptoms of the disease; and lastly, there is *determination*, the result, whether recovery through convalescence, or death. These infectious diseases frequently present themselves in *epidemic* form—that is, they become prevalent more or less suddenly over a larger or smaller area. They may, however, become attached more or less permanently to certain localities or regions of the globe, in which case they are termed *endemic* diseases. A disease is *pandemic* when it diffuses itself generally over the world.

SMALL-POX

Incubation period, 12 to 14 days; quarantine, 18 days. The chief symptoms are shivering, high temperature, headache, pains in the small of the back, and often vomiting. On the third or fourth day the rash appears as red pimples on forehead, neck, face, and limbs, particularly on the wrists and ankles. When the rash comes out the patient generally feels better. The pimples

Symptoms.

enlarge, are "shotty," and become vesicles or "pocks," which become pustular about the eighth day, scabbing from the ninth to the tenth days, and declining about the twelfth or fourteenth day of the fever, when danger to life is greatest.

The disease is highly infectious—perhaps the most infectious of all the fevers. Until vaccination came into use small-pox was the cause of great suffering, disfigurement, and mortality. Even as late as 1871-2 42,000 persons died of this disease in England alone. During the seventeenth and eighteenth centuries from 7 to 18 per cent. of all persons buried in London had died of it. It is difficult for us to realise what a terrible scourge this disease was in former times.

Channels of Infection.

In reference to the channels of infection, an examination of small-pox records can lead to but one conclusion. It is, of course, that almost all cases are derived from previous cases by contact. Food (including milk), contaminated water, defective drainage, and the other sources to which epidemic disease is at times traceable, have played comparatively little part in the spread of the disease. Attention must therefore be directed to places where persons or things may have come into contact with recognised or unrecognised cases of small-pox. Hence laundries, common lodging-houses, workshops, clubs, overcrowded tenements, and similar properties have provided the main opportunities for the spread of the disease.

The infection of small-pox is so subtle and so readily spread, and the disease is, in some cases, so mild and so easily concealed, that no one can tell when he may be exposed to it and thus attacked by it unawares. It would appear that the infection is mainly given off (1) by the skin of persons suffering from small-pox, possibly during the incubation stage, certainly in the initial stage, but most virulently when the skin is pustular or scabbing; (2) by bodies of persons who have died from small-pox; (3) by infected articles and anything handled by the patient; (4) by healthy third persons who have been in contact with the disease; (5) by the air from small-pox hospitals, houses, or patients. Hence the importance of rapid and total isolation of each case.

The question naturally arises, What are the conditions affecting the prevalence of the disease? The answer is that they are mainly four:—

1. The amount of small-pox in other parts of England.

2. The prompt recognition of any cases of small-pox, and their early isolation to hospital.

3. The state of vaccination of the community.

4. General sanitation and freedom from overcrowding.

CHICKEN-POX

Incubation period, 12 to 14 days; quarantine, 18 days. There are no premonitory symptoms as in small-pox, but the rash comes out first.

Symptoms. The pimples begin as in small-pox, but are most marked on the face and body generally, and proportionately less on the limbs. The vesicles do not become pustules, and they appear in successive crops, giving the eruption a more varied appearance than that of small-pox. The disease is important chiefly because of its similarity to small-pox, with which it may be confused. Serious outbreaks of small-pox have been caused when the reverse was the case and small-pox has been mistaken for chicken-pox.

MEASLES

Incubation period, 12 to 14 days; quarantine, 21 days. The symptoms are sneezing, cold in the head and eyes, rise of temperature, and

Symptoms. sometimes aching pains and vomiting. The rash appears on the face on the fourth day, is blotchy, irregular, and of a purplish red tint. It is distributed over all parts of the body. It begins to fade on the seventh or eighth day, when the fever usually declines suddenly. There may be a slight peeling of the skin, like scales of bran.

Measles is chiefly a disease of childhood, and is very infectious, even before the rash comes out, which is the reason why it spreads so badly in schools and villages. Children having measles should be put to bed as soon as possible and kept warm, otherwise lung complications (bronchitis, pneumonia, etc.) may supervene. Most of the deaths due to measles are brought about by these complications. The mortality is highest in the second year of life, and upwards of 90 per cent. of all deaths from measles occur in children under five years of age. It is not too much to say that most of the deaths from measles could be avoided by greater carefulness in nursing and avoiding exposure to cold. It should not be forgotten that measles also predisposes to tuberculosis.

GERMAN MEASLES

Incubation period, 12 to 14 days; quarantine, 21 days. This is not a serious disease, although infectious. It is similar to measles, but is not preceded by sneezing and catarrh. Sometimes there is a sore throat, and thus the disease may at first be mistaken for scarlet fever. The rash is red, slightly elevated above the surface of the skin, and sometimes the red spots are confluent. It appears first on the face and forearms.

Symptoms.

SCARLET FEVER

Incubation period, 2 to 6 days; quarantine, 14 days. The onset is sudden. Sore throat, shivering, rise of temperature, vomiting (often apparently the first symptom, and mistaken for a bilious attack), and hot, dry skin are the commencing signs. A diffused, uniform red rash appears on the second day, on the neck and chest at first, but spreading all over the body (the face usually remaining clear), and disappearing at the end of a week, when peeling begins. This peeling process may last for about a week or for as long a period as four or five weeks. During this time it is important to avoid chill, which is liable to set up kidney complications. Some cases are very mild, and although most infectious, may thus escape recognition. A child sometimes erroneously thought to have recovered may have a discharge from the ear or nose, or puffiness of the eyelids (dropsy). Such discharges are highly infectious. The virus of scarlet fever clings to premises and clothing, sometimes for long periods of time. The commonest mode of infection is by contact, but the disease may be spread also by milk and other foods. There is no evidence that it can be water-borne.

Symptoms.

DIPHTHERIA

Incubation period, 2 to 3 days; quarantine, 28 days. The symptoms of sore throat, shivering, headache, rise of temperature, and dulness and general weakness usher in the disease, which is characterised also by greyish white patches on the back of the throat, foul breath, and swollen glands below the angle of the jaw or in the neck. The kidneys may be affected, and heart failure and slight paralysis are not uncommon.

Symptoms.

Although sometimes a severe disease, diphtheria may be so mild as to escape recognition. Yet such cases may start an epidemic. Persons

apparently quite well may carry the germ in their throats, and so act as " carrier " cases. No person who has had diphtheria should be considered free from infection until at least two consecutive bacteriological examinations of the throat have proved negative as regards the presence of the diphtheria bacillus.

TYPHOID (ENTERIC) FEVER

Incubation period, 7 to 21 days, usually 12 to 14; quarantine, 28 days. The disease may take a number of days to develop. The early

Symptoms.

symptoms are shivering, rise of temperature, headache, general malaise, and often diarrhœa. A rose-coloured rash of a few raised spots, like flea-bites, sometimes appears on the abdomen about the third day. The fever declines in the third week, which is usually the dangerous period. No solid food must be given for about five weeks from the commencement of the fever, and during the whole period the patient should be kept constantly lying down.

TYPHUS FEVER

Incubation period, 4 to 12 days; quarantine, 28 days. This disease is rare except in Ireland and Russia, and only affects persons living

Symptoms.

under highly insanitary, overcrowded, and ill-ventilated conditions. It follows in the wake of semi-starvation and debility. It begins with shivering, high fever, headache, and delirium. A peculiar dirty-looking mottled rash of a purple tint comes out about the fifth day. The fever lasts a fortnight, during a large part of which time the patient may be unconscious.

MUMPS (PAROTITIS)

Incubation period, 14 to 21 days; quarantine, 30 days. The symptoms are pain and enlargement of the salivary glands in front of the ears, with stiffness of the jaws. An extremely infectious but rarely dangerous disease, usually occurring in winter or spring.

WHOOPING-COUGH (PERTUSSIS)

Incubation period, 4 to 10 days; quarantine, 21 days. This is a disease

Symptoms.

of young children, not unfrequently fatal. It begins with ordinary cough, which in a few days becomes a " whoop " as the breath is drawn in, and then a paroxysm of coughing

follows in a torrent-like fashion, often until the child is sick. Lung complications are common. The disease is very infectious, and most prevalent in the spring. The greatest mortality occurs in the first and second years of life. Children affected should be kept indoors and not exposed to cold in any degree.

EPIDEMIC DIARRHŒA

Epidemic diarrhœa (sometimes called epidemic enteritis), like tuberculosis, is not one of the ordinary infectious diseases. It has been described at some length in Part II. of this work, but as it is more common and more fatal than most of the other infectious diseases put together, brief reference will be made to it here from the public health point of view. Whilst it may affect persons of any age, it is chiefly a disease of children under two. It rarely occurs in breast-fed children, and scarcely ever in breast-fed children under four months of age. It is most prevalent in the summer months, a hot, dry summer being much more favourable to the disease than a cool wet season. The symptoms are diarrhœa, vomiting, convulsions, and collapse. The disease may only last a few days before a fatal issue. It affects apparently healthy as well as weakly children. It is probably due to pollution of food —particularly milk—in a weaned child, the pollution being more common and greater in degree in hot dusty weather. It is mainly a disease of urban communities, of the poorer classes, and of dirty homes.

Some authorities believe that the essential cause of the disease resides in the soil ; others hold that the agent of infection is carried from manure, refuse, and filth to food by means of flies. Certainly it can be shown that epidemic diarrhœa occurs only or chiefly when the temperature of the soil at the depth of four feet is high (56° F.), and that it is more prevalent in seasons characterised by an exceptional number of flies. We also know that flies do, in fact, carry pollution to food. To prevent the disease great care should be taken in respect to the feeding of infants and children, and breast-fed infants should be weaned before the beginning of July or after the end of September.

TUBERCULOSIS

As has been explained elsewhere in this work, tuberculosis is a disease which manifests itself in various forms. It is not, like most of the above diseases, of comparatively short duration, nor has it a definite period of incubation. It is, however, one of the most important of all the

infectious diseases. In England and Wales it kills every year not less than 50,000 persons. In London alone it kills 8,000 people every year, and the vast majority of its victims are young men and women in the prime of life. It is caused by the tubercle bacillus, discovered by Koch in 1882—a widely distributed microbe, and one of the most resistant of all the disease-producing germs. Tuberculosis takes different forms according as different parts of the body are attacked by this organism.

The germ may gain entrance through the skin, or by way of the alimentary canal, or through the respiratory tract. Whatever way it enters, it sets up a similar kind of disease, though its exact form is dependent a good deal upon the tissues which are attacked. In the first place the bacillus sets up an inflammatory irritation, at or near the point of introduction. In the second place it exerts a specific effect by means of the products or toxins which result from its action in the tissues. In the lung these changes lead first to the honeycomb tissue becoming solid, the air vesicles being clogged with the nodules or tubercles of infection. Then these tubercles "break down" and disintegrate, and we get the lung discharging in the form of "expectoration," which is coughed up owing to the irritation which it sets up. Thus we get a cavity left behind in the lung, and the infective matter becomes distributed as sputum.

It is, in fact, by the cough spray, that is, the particles of infective matter in the saliva which are expelled in the act of coughing, and by the sputum, that the disease is spread. The sputum is coughed up, falls on the ground, and dries, and its dust, mixing with the dust of the street or room, is carried hither and thither by air currents. The inhalation of this dust by healthy persons may be the beginning of infection. "The main source of the infection of tuberculosis," said Koch, "is the sputum of consumptive patients."

Although human channels of infection are the principal means of the spread of the disease, it must not be forgotten that it may be contracted from milk derived from tuberculous cows. Market milk has been found not unfrequently to contain the tubercle bacillus, and it has been shown that bovine tuberculosis can set up the disease in man. "Cow's milk containing bovine tubercle bacilli," reported the Royal Commission on Tuberculosis in 1907, "is clearly a cause of tuberculosis, and of fatal tuberculosis, in man." The

Tuberculous Milk.

Commission added "that a very considerable amount of disease and loss of life, especially among the young, must be attributed to the consumption of cow's milk containing tubercle bacilli."

Seed and Soil.

Tuberculosis illustrates how both seed and soil play a part in the production of disease. We know that tuberculosis is an acquired disease rather than an hereditary one, and that its contraction is dependent primarily upon the introduction of the tubercle bacillus. But of scarcely less importance is the soil. There are at least five predisposing conditions which favour tuberculosis. First, there are certain bodily conditions, habits, and diseases. Mouth-breathing, weak chests, ill-formed and contracted chests, and measles, bronchitis, catarrh, and adenoids, predispose to tuberculosis. Then, secondly, there is the effect of bad housing in dirty, dark, damp dwellings, which not only exert an evil influence on the individual and bring about debility, but which also remain infected from the tuberculous sputum and dust of previous cases. Thirdly, there is overcrowding. The counties and towns which have most overcrowding suffer most from phthisis. Fourthly, there is occupation. Cramped and constrained positions of the body at work, which interfere with the full play of the lungs, such as occur in the work of miners, cobblers, lace-workers, bookbinders; night work; hot, ill-ventilated workrooms; and all trade processes in which the air is charged with dust of an irritating kind, conduce to phthisis. Lastly, there is alcoholism, which is, in the view of Brouardel, "the most potent factor in propagating tuberculosis," partly by its debilitating effect, and partly by the inhalation of tuberculous dust from dried sputum on the floor of the public-house.

CHAPTER XCVII

PUBLIC HEALTH (*continued*): METHODS OF PREVENTION OF INFECTIOUS DISEASE

Preventive Methods in the Middle Ages—Notification—Control of Channels of Infection—Isolation in the Hospital and in the Home—Disinfection—How to Disinfect after or during Consumption.

Preventive Methods in the Middle Ages.

THE modern methods of preventing the spread of infectious disease are the result of the slow evolution of sanitary government. Down to the Middle Ages, men looked upon disease as the visitation or punishment of the gods, or at least associated it with Fate. They feared it as something of which they knew neither the origin nor the means of control. They dealt with it on traditional lines, renewed their religious vows, did penance, or made flight into seclusion. We know what their practice was in these critical situations from the attempts made to stamp out leprosy, which was at one time a prevalent disease in these islands. The Pope issued bulls and the King edicts. Regulations were made, and more or less enforced, for preventing lepers from sharing in the ordinary citizen's life and liberty. They were herded together in small huts and lazarettoes at the gates of the towns ; they were fed by doles from the food entering the towns; and they were permitted to observe the raising of the Host in the churches only from outside through squint windows.

Obviously these regulations did not touch the disease, except in so far as they kept lepers distinct and separate from the rest of the community. The Middle Ages are marked in history as a time of pestilence, when plague and leprosy walked abroad at noonday, and tens of thousands of people suffered from ague, scurvy, gaol fever, and small-pox. It was, indeed, mainly the widespread suffering and heavy mortality that forced people to see that unless something were done to prevent these diseases the strength of the State itself would be undermined.

The public health is the greatest asset of any nation. Hence, as a result of investigation and inquiry at the beginning of the nineteenth century, Parliament began, towards the middle of that century, to pass laws making provision for the compulsory prevention of disease. The first thing necessary was obvious. It was to find out where infectious disease was actually occurring, and this was achieved by a system of notification.

I. NOTIFICATION

The notification of infectious diseases is provided for by the Public Health (London) Act, 1891, in the metropolis, and the Infectious Diseases Notification Act in the country. Under these Acts it is the duty of the family or the medical attendant, "as soon as he becomes aware" of the existence of certain diseases, "forthwith" to certify the fact to the Medical Officer of Health of the district in which the house is situated. This certificate or notification must state the name, age, sex, address, and the disease from which the patient is suffering. This system applies to small-pox, cholera, diphtheria, membranous croup, erysipelas, scarlet fever, typhoid fever, typhus, relapsing, continued and puerperal fevers, and phthisis. The duty generally devolves in practice upon the medical attendant, and there are penalties for neglect. The local Sanitary Authority may, if it thinks fit, extend notification to other diseases with the approval of the Local Government Board, and in this way measles, chicken-pox, and "spotted fever" (cerebro-spinal meningitis) have been made notifiable for longer or shorter periods. In London and many other sanitary areas ophthalmia in newborn children is now notifiable.

The system has also been employed in a voluntary and non-compulsory way to other diseases, such as epidemic diarrhœa. Certain other infectious diseases, such as measles, whooping-cough, and mumps, occurring mostly in children at school ages, though not notifiable by law, are certified by the school authorities to the local Sanitary Authority, which thus gains information as to the incidence of such diseases.

Advantages.

The advantages of notification are obvious. It guides the Medical Officer of Health as to the more or less exact distribution and occurrence of infectious diseases. He is able to make a register of these diseases, and, if he so desires, a "spot map" of the district also, showing the whereabouts of the affected persons and their relation to schools, milk-shops, workshops, and so on. He is thus enabled

in the first place to carry out intelligent investigation as to channels of infection, and in the second place to bring his other preventive methods to bear on the spot where they are most required.

2. CONTROL OF CHANNELS OF INFECTION

The control of channels of infection comes next in order of prevention. Stop the source of infection. If the disease be water- or milk-borne, stop the supply of the infected water or milk. If it be due to personal contact, prevent such contact as far as may be. If due to the school, close it, or prevent the attendance of children from infected homes. If it be due to infected materials, have them disinfected. Whatever can be shown to be a means of spread must be dealt with summarily. At the time of epidemic such steps must be vigorous, but it is more scientific and, of course, more effectual if channels of infection can be controlled *before* the emergency arises. What we need are supervision and control of schools, milk supplies, water supplies, housing, etc., in such a way as to avoid the occasion of disease. Still more desirable is it to lay emphasis on the need for personal hygiene and the care of the body, in order that the soil on which passing germs of infection may fall shall be so healthy and resistant as to prove a wholly unfavourable nidus for disease.

3. ISOLATION

As soon after notification as possible, the affected person must be isolated from his family and from the rest of the community, either in his own home, if that be practicable, or in a special isolation hospital for infectious diseases. The latter course may be enforced by a magistrate if it is not possible to provide adequate and suitable isolation at home. The advantages of such removal greatly overbalance the disadvantages, for while it is very unpleasant for the sick person to be separated from his relatives and home when he particularly needs both, it is essential that the interests of the community should be considered. Moreover, the patient himself secures both medical attention and nursing in a good hospital, and the burden of management, of inconvenience, and of expense is removed from the family.

In Hospital.

But in some cases in poorer homes, and in almost all cases in richer homes, the patient can be isolated at home. What, then, are the requirements to be met? It is impossible to lay down rules for all cases and suitable for all circumstances. But

In the Home.

the following rules will generally meet the case and indicate the main lines of precaution :—

1. When a person is attacked with infectious disease, the patient must be placed in a separate room, and all carpets, curtains, etc., at once removed.

Rules for Home Isolation.

2. If the disease be small-pox, all in the house should be submitted to medical examination, and vaccinated or re-vaccinated if deemed necessary.

3. In all cases the evacuations of the patient should be mixed with carbolic water before removal from the room; and every soiled article should be soaked in carbolic water before being washed.

4. A sheet wetted with carbolic water may be hung up immediately outside the patient's room. Keep it wet by dipping the lower corner in a vessel of the disinfectant.

5. The least possible communication should take place between the nurse or attending relative and the other inmates of the house. Persons remaining for any time in an infected room, and then mixing with others, can spread the infection without necessarily suffering themselves.

6. When infectious disease is rife, neighbours ought to avoid entirely the practice of *visiting from house to house*, as infection is very often carried by the clothing to other families.

7. No child should be allowed to attend *school* from a house where any infectious case exists, until a certificate has been received from the medical attendant, or the Medical Officer of Health, stating that the child can do so without the risk of conveying infection to others. We are now aware that on many occasions infection is spread by a neglect of this precaution, and the public should be warned that such neglect constitutes an offence under the Public Health Act.

8. All drains, closets, or privies near or about the house into which any discharges from the patient have been emptied should be disinfected every day.

9. Persons nursing infectious cases should wear dresses which can be readily disinfected and washed.

10. It is necessary to remember that the danger of infection continues for a long time after the patient has apparently recovered; in scarlet fever cases the infection lasts for from five to six weeks after the child has "recovered from the fever," or as long as there is any peeling or roughness of the skin. The time that the infection of whooping-cough,

fever, measles, or diphtheria lasts is so varied and uncertain that the only safe course is to be guided as to freedom from infection by the medical attendant, or by the Medical Officer of Health.

11. As milk and water frequently convey infection, it is a wise precaution, when infectious illness occurs in a house, to boil all milk and water before use.

12. After the recovery of the case, the sick room should be properly disinfected, with the windows, fireplace, and doors carefully closed, every person having previously quitted the room ; the bedding and wearing apparel which cannot be washed should be spread out and exposed to the disinfectant in the room.

4. DISINFECTION

Disinfection is the process of killing the infective agent. Some chemical substances merely arrest the development of germs (*antiseptics*), others only remove the unpleasant smell of decomposition (*deodorants*), and a third series of substances or means actually kill the germ (*germicides* or *disinfectants*). It is the last-named which are used in practice after infectious disease. The house where the patient has lived, his clothes, his bedding, furniture, books, etc., need cleansing or disinfecting. Such disinfection may be carried out in several ways—*e.g.* by using heat, by treating with chemicals, or by thorough cleansing. As this is a matter of the greatest importance it must be referred to at length and in detail.

The chief idea to be borne in mind in all disinfection is that of *cleansing*, either with soap and water or with water and some chemical. Gaseous disinfection has its advantages (penetration, and so on), but it is *the cleansing of infected surfaces* of rooms, furniture, clothing, or even the human body, which is the most important thing to keep in mind. If that be properly and effectually done other things will come right. If that be ignored no amount of gaseous disinfection will wholly meet the case.

That being the general principle, we may consider the various ways in which efficient disinfection is carried out, and the objects to which it should be applied :—

Methods of Disinfection.

1. *Excreta and discharges.*—Disinfection of discharges should be carried out continuously throughout the illness, and the Medical Officer of Health will be ready to assist and advise in all cases of infectious disease. To disinfect excreta, enough

disinfectant should be added to produce in the solution or matter being disinfected the necessary percentage of disinfectant. Adding a small quantity of antiseptic to a large volume of fluid or solid is as useless as pouring a small quantity of antiseptic down a sewer with the object of disinfecting the sewage. The mixture of the disinfectant with the matter to be disinfected must contain the standard percentage for disinfection. Substances recommended are chloride of lime (¼ lb. to the gallon of water), potassium permanganate (1 in 100), carbolic acid (5 per cent.), corrosive sublimate, lysol, cyllin, izal, etc. Excreta and disinfectant should be mixed and stand for half an hour before being put down the drain. Sputum from a case of consumption should be disinfected in carbolic acid solution (5 per cent.).

2. *To disinfect the hands.*—Wash in carbolic acid solution (1 in 20 or 1 in 40).

3. *Bed-clothes, wearing apparel, carpets, curtains, etc.*—Steam disinfection is best. If that is not available, soak in carbolic (5 per cent.) or chloride of lime, then thoroughly wash. Rags and handkerchiefs may be burnt.

4. *Letters and books.*—Use steam, or if such articles have leather coverings bake in an oven, or formaldehyde may be used in a cupboard.

5. *To disinfect a room.*—The walls, floor, and furniture may be washed with one of the disinfectant solutions or water. Furniture may be wiped down with carbolic acid solution (1 in 40).

In order to remove and destroy the dried infective discharges, the disinfectant must be applied *directly to the infected surfaces* of the room. The disinfectant may be applied by washing, brushing, or spraying. Amongst other chemical solutions used for this purpose a solution of chloride of lime (1 to 2 per cent.) has proved satisfactory and efficient. Formalin (40 per cent.) is also used by many authorities. In view of the well-established fact that it is the dust from dried discharges which is chiefly infective, emphasis must be laid upon the importance of thorough and wet cleansing of infected rooms.

6. *How to conduct gaseous disinfection.*

(*a*) *Sulphur.*—Sulphur is almost useless as a gaseous disinfectant unless used in a particular way. The following seem to be the only lines upon which anything like adequate disinfection can be secured by means of this drug : (1) The room to be disinfected must be *effectually* sealed up. (2) Not less than 3 lbs. of sulphur should be used

for every 1,000 cubic feet. (3) Twenty-four hours should elapse between the time of lighting the sulphur and the unsealing of the room. (4) The air in the room should be *damp* during the process, and this may be achieved by steam, or spraying the walls with water, or suspending wet blankets. By this means sulphurous acid is formed, which is the essential part of the process. (5) At the end of the twenty-four hours the doors and windows should be kept wide open for at least one, and if possible two days. (6) Furniture and fixtures should as far as possible be wiped down with a damp cloth soaked in carbolic or some other disinfectant solution. Dry dusting or sweeping should be strongly deprecated. The walls may be stripped in cases where they are very dirty or where there has been a recurrence of disease.

(*b*) *Formic aldehyde* is probably the best gaseous disinfectant, and it is more rapid than sulphur. Formic aldehyde as a germicide when used in gaseous form, or as formalin in solution, is much more efficacious than sulphur as ordinarily used. Almost its only drawback is that it is somewhat more expensive than sulphur. Formic aldehyde gas is produced by burning tabloids (30 to every 1,000 cubic feet) in a small "alformant lamp." The gas is harmless to colours, metal, and polished wood. The vapour acts best in a warm atmosphere. In a cupboard with a small formaldehyde lamp many domestic and personal articles may be suitably disinfected which would be spoiled by disinfection with solutions or with steam.

5. HOW TO DISINFECT AFTER OR DURING CONSUMPTION

The National Association for the Prevention of Consumption has issued a circular setting forth exactly how disinfection should be carried out in a house after the death of a person from phthisis, or at suitable intervals (say two or three times a year) during the illness. It is unnecessary to quote the whole statement, but the following conclusions may be given here:—

"Disinfection of rooms which have been occupied by consumptive patients may be secured in various ways, but the following are the practical rules which must underlie any methods adopted:—

Disinfection of Rooms.

"1. Gaseous disinfection of rooms, or 'fumigation,' as it is termed, by whatever method it is practised, is inefficient in such cases.

"2. In order to remove and destroy the dried infective discharges,

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SERJEANT-SURGEON TO H.M. THE KING.

the disinfectant must be applied *directly to the infected surfaces* of the room.

"3. The disinfectant may be applied by washing, brushing, or spraying.

"4. Amongst other chemical solutions used for this purpose a solution of chloride of lime (1 to 2 per cent.) has proved satisfactory and efficient.

"5. In view of the well-established fact that it is the dust from dried discharges which is chiefly infective, emphasis must be laid upon the importance of thorough and wet cleansing of infected rooms.

"6. Bedding, carpets, curtains, wearing apparel, and all similar articles belonging to or used by the patient, which cannot be thoroughly washed, should be disinfected in an efficient steam disinfector.

"7. After all necessary measures of disinfection have been carried out, the essential principle governing the subsequent control of a case of consumption is that all discharges, of whatever kind (especially expectoration from the lungs), should under no circumstances be allowed to become dry."

Esmarch's Method.

In houses which are in a clean condition, and where it is certain that there has been no direct soiling of the walls or floors with sputum, and where the infectious dust, if present, has come from soiled pocket-handkerchiefs or articles of clothing, the chlorinated lime method of disinfection is not necessary, and the method of disinfection recommended by Esmarch is often practised.

The wall-paper is well rubbed with crumb of bread, or with dough kneaded to a proper consistency. Floors, painted walls, and woodwork are washed with soap and water, and ceilings are limewashed. In addition, bedding, articles of clothing, etc., are either disinfected by steam or washed with boiling water.

This method of disinfection, when properly carried out, has been found to remove practically all dust from a room, so that little or no dust can be obtained by subsequently rubbing the wall-paper with a sterilised sponge. The method, however, requires a certain amount of care to make sure that all dust is removed from the walls, especially from the angles and corners, and properly to rub down a fair-sized room takes a considerable time. It is useless in cases where the paper is directly soiled with sputum.

CHAPTER XCVIII

PUBLIC HEALTH (*continued*): PREVENTIVE INOCULATION

Toxins and Anti-bodies—Immunity—Vaccination—Its Origin—Results—The Conclusions of the Royal Commission of 1896—Is Vaccination Harmful?—Diphtheria Anti-toxin—Four Great Preventive Principles.

If disease be left to itself, so to speak, to do its worst, it ends either in the death of the patient or his *natural recovery*. Have we ever asked ourselves what natural recovery means, and to what it is due? We usually attribute it to good luck or accident, or possibly to some fancied treatment of our own, which in all probability had nothing whatever to do with it. To what, then, is it due? The answer is a simple one, and its accuracy cannot be doubted. Natural recovery is due to the exhaustion of the virus *or* to the successful resistance of the body both to the germs of disease and to their products. As we have already seen, germs of disease, when they have gained an entrance to the human body, set up disease by their products or toxins. These toxins either remain local at the site of entrance and from thence produce their effects, or they circulate throughout the body, bringing about general effects.

Anti-bodies.

Now in recent years a wonderful thing has been discovered about these poisonous substances, which, stated in few words, is this: By their action and interaction in the blood and body tissues, they stimulate—perhaps even produce—some kind of "anti-bodies," which, in their turn, act as protectors and resisting cells and substances against the poison. Thus there ensues in the body of the patient a struggle between the toxins (or poisons of infection) and the anti-bodies (or protectors). If the former triumph, the patient dies; if the latter, he recovers. But more than that, if he recovers there is left in his tissues, so to speak, an overdose of anti-bodies which successfully repels any further invasion of the same infection. He does

not, in fact, suffer from that disease again. He is protected from it by the new defences resulting from his first attack. This protection we call *immunity*. We know, too, that some races of men and animals are immune against certain diseases. Some individuals also have a natural immunity from disease. It is clear, therefore, that there are various forms of this protection.

Immunity.

Our knowledge of immunity and how it is produced lies at the foundation of the new medicine of preventive inoculation. It was Metchnikoff, the famous Russian investigator, who first demonstrated that certain cells in the living body did the work of "scavengers," passing to and fro in the body, overtaking germs of disease and absorbing them into their own protoplasm, and thus, of course, absolutely destroying them. These scavenging cells—or *phagocytes*, as they are called—are normally present in the healthy body, and make it insusceptible to certain diseases. They protect it and create for it a greater or less degree of immunity. In 1904 Sir Almroth Wright, an English bacteriologist, added to our knowledge respecting the work of these phagocytes, for he discovered that even if these protecting cells be removed from the blood, the blood itself still possesses protective properties. He found, in short, that the healthy blood itself contains substances which combine with germs in such a way as to prepare them for the phagocytes, and that without these substances the phagocytes could not fulfil their complete task. He called these new bodies *opsonins* (from a word meaning prepared food). Possibly these substances are secreted by the phagocytes, which may after all be the essential elements in producing immunity. But into these matters we cannot here go. What we have to understand quite clearly is that Nature protects the body, up to a certain point, against disease. Men have actually found this to be so, to the saving of life and the reduction of disease. And more than this, they have attempted to imitate Nature and learn her secret. For if we can *add* to the human body or the human blood such protective substances, we can defeat disease when it comes, or, what is better still, we can create defences against it before it comes. Upon this broad foundation rest the claims of what is called the inoculation or serum treatment. Examples of it occur in vaccination for small-pox and the anti-toxin treatment of diphtheria. It is now necessary, therefore, to discuss these two illustrations of preventive medicine.

VACCINATION

So greatly dreaded was small-pox, particularly in the seventeenth and eighteenth centuries, that men actually preferred to have a mild attack, produced by artificial inoculation from a mild case of the disease, than run the great risks—as they then were—of a severe attack contracted by infection at a time of prevalence or great fatality. This method of inoculating small-pox (or variola) was known as *variolation*. It was based on the principle that one attack protected, in some degree, against subsequent attack. There were various methods of performing the operation of variolation, but the common practice was arm-to-arm inoculation. As a rule, only local results followed, or a comparatively mild attack of a general character, and the person was protected. It was, none the less, actually inoculating small-pox, and was a means of breeding the disease and creating fresh centres. In 1840, therefore, for this and other reasons, variolation was prohibited by Act of Parliament.

Variolation.

More than a hundred years ago, in 1796, Edward Jenner, a medical practitioner in Gloucestershire, made the discovery that those of his patients who had, or had had, *vaccinia* or cow-pox did not suffer from small-pox. They not only failed to contract the disease after ample exposure to contagion, such as nursing or even sleeping with persons suffering from small-pox, but even if inoculated by the process of variolation then usual the inoculation failed to excite small-pox. From this experience it was but a step to argue that similar protection against small-pox might be obtained by inoculating cow-pox—or, in other words, by *vaccination* instead of variolation. This Jenner did with good results, and in due course, after much opposition, the practice of vaccination took the place of small-pox inoculation.

Origin of Vaccination.

From what we have already said the science at the back of both variolation and vaccination is evident—at least in its broad basis. By both methods the anti-bodies of small-pox are increased in the blood of the patient, in the former method by an artificial attack of small-pox, in the latter by an attack of vaccinia. From 1798 onwards, evidence accumulated of the value of vaccination as a protection in greater or less degree against small-pox, and in 1840 the Vaccination Act provided for gratuitous though optional vaccination. In 1854 it was made compulsory, and from that time various statutory arrangements were made

for its provision. In recent years—notably in 1898 and 1907—greater latitude has been allowed to the conscientious objector.

Speaking generally, it may be said that each extension of vaccination in England and abroad has been attended with a reduction in small-pox mortality, greatest at the ages of highest mortality (that is, under 10 years), and least in adults, and that whereas a century ago small-pox was a pestilence of the first magnitude, it is now a rare disease. It is sometimes said that this remarkable diminution of small-pox is due to improvement in sanitation and not to vaccination. There can be no doubt that improved sanitation, with rapid isolation of affected persons, does aid very greatly. But if it were the only agency, or even the main agency, we should expect (1) a general proportional decline in all other infectious diseases, and (2) a particular decline of small-pox at all ages in relation to sanitation, for improved sanitation affects all. Yet we do not find these evidences. On the contrary, the general death-rate, including infectious diseases, has declined in the last half century only some 10 per cent. in comparison with a decline of small-pox in the same period of more than 70 per cent. And again, we find that small-pox has declined not mostly in proportion to sanitation, but mostly in relation to vaccination, children and infants who have been vaccinated suffering *less* than adults rather than more, though their age is more susceptible to disease. This question of the age incidence of small-pox in vaccinated and unvaccinated people is clearly shown in the official returns of the Metropolitan Asylums Board of the 9,658 cases of small-pox occurring in the epidemic of 1902. They will be found on the next page.

Results of Vaccination.

Age Incidence of Small-pox.

From these figures it will be seen—

(*a*) *That under* 5 *years of age* 18 cases of small-pox occurred in children who had been vaccinated, whilst 711 cases occurred in children who had not been vaccinated.

(*b*) *That under* 10 *years of age* the cases of small-pox in vaccinated persons had a mortality percentage of 1·72, and the unvaccinated cases had an average mortality percentage of over 42.

(*c*) *That under* 20 *years of age* the cases of small-pox occurring in vaccinated persons had a mortality percentage of 1·93, and the unvaccinated cases had a mortality percentage of 31·27.

(*d*) *That over* 20 *years of age* the cases of small-pox occurring in

Ages	Vaccinated			Unknown			Unvaccinated			Total cases and deaths		
	Cases	*Deaths*	*Mortality per cent.*	*Cases*	*Deaths*	*Mortality per cent.*	*Cases*	*Deaths*	*Mortality per cent.*	*Cases*	*Deaths*	*Mortality per cent.*
Years.												
Under 1	—	—	—	—	—	—	187	130	69·52	187	130	69·52
1 to 5	18	—	—	7	1	14·28	524	209	39·88	549	210	38·25
5 ,, 10	116	2	1·72	26	5	19·23	563	103	18·29	705	110	15·60
10 ,, 15	334	4	1·19	29	5	17·24	386	88	22·79	749	97	12·95
15 ,, 20	829	19	2·29	44	10	22·73	233	62·	26·62	1106	91	8·22
Total under 20	1297	25	1·93	106	21	19·81	1893	592	31·27	3296	658	19·35
20 to 25	1274	60	4·71	49	16	32·65	149	47	31·54	1472	123	8·35
25 ,, 30	1243	87	7·00	49	24	48·98	94	38	40·43	1386	149	10·75
30 ,, 35	997	111	11·13	45	21	46·67	52	22	42·31	1094	154	14·07
35 ,, 40	758	137	18·07	32	15	46·87	38	19	50·00	828	171	20·65
40 ,, 50	893	188	21·05	62	33	53·23	31	24	77·42	986	245	24·84
50 ,, 60	320	61	19·06	52	23	44·23	13	8	61·54	385	92	23·89
60 ,, 70	126	30	23·8	25	8	32·00	5	—	—	156	38	24·39
70 ,, 80	31	5	16·13	15	9	60·00	1	1	100·00	47	15	31·91
80	6	1	16·67	1	1	100·00	1	1	100·00	8	3	37·50
Total between 20 & 80	5648	680	12·04	330	150	45·45	384	160	41·66	6362	990	15·36
Grand Total	6945	705	10·15	436	171	39·22	2277	752	33·03	9658	1628	16·85

vaccinated persons numbered 5,648 and there were 680 deaths, giving a mortality percentage of 12·04; whereas the cases occurring in unvaccinated persons were 384, 160 of whom died, giving a mortality percentage of 41·66. (The larger number of cases of small-pox in vaccinated persons is, of course, due to the fact that by far the larger proportion of the population at this age period have at some time or other in their lives been vaccinated.)

There is a further subsidiary point which is of importance as collateral evidence and which has relation to the degree of mortality following *efficient* vaccination. This may be measured, as is frequently done, by the number of marks, but it is more satisfactorily measured by area of vaccination mark (*i.e.* area of cicatrix). The return of the Metropolitan Asylums Board respecting this point is given here, and a study of it will amply prove the claim made :—

	Admissions	*Deaths*	*Mortality per cent.*
Vaccinated cases—			
Area of cicatrix—			
Half and upwards of half square inch	5,163	379	7·34
Area of cicatrix—			
One third but less than half square inch	835	131	15·69
Area of cicatrix—			
Less than one third square inch .	860	162	16·87
Area of cicatrix—			
Not recorded	87	33	37·93
Totals of vaccinated class .	6,945	705	10·15
Unknown and doubtful class . . .	436	171	39·22
Unvaccinated class	2,277	752	33·06
Grand totals	9,658	1,628	16·87

In the main it may be said respecting small-pox as it occurs in England in the present day, that there are three propositions generally accepted as true :—

(1) That small-pox among the vaccinated is nowadays mainly a disease of adults, because children are protected by primary vaccination and adults are not protected by re-vaccination.

(2) That among the unvaccinated, small-pox is still, in great measure, a disease of the young, as it was in pre-vaccination days.

(3) That the mortality rate among the vaccinated is *at all ages* much less than among the unvaccinated, and that this difference is very striking and complete in children because of their recent vaccination.

Those who advocate vaccination and re-vaccination as protective

in a greater or less degree against small-pox, do so upon three chief grounds. In the first place, they claim that, other things being equal, persons who have been vaccinated (especially within ten years) *are less liable to attack* from small-pox. In the second place, they claim that persons who have been vaccinated, and yet, on account of their greater number in the population, and therefore their consequent greater probability of infection, are attacked by small-pox, *do not die so readily from the disease* as those who have not been vaccinated. In the third place, they claim that persons who have been vaccinated, and yet who have been attacked, *do not suffer so greatly from the disease* as those who have not been vaccinated.

The only method we have of measuring the severity of the disease in each case is by considering the number of days for which each case is detained in hospital, because it is evident that the more severe cases will be detained for treatment longer than the less severe cases. Speaking generally and from a large body of statistics, it has been found that persons suffering from small-pox, and who have not been vaccinated, have to remain under treatment twice as long as persons who have been vaccinated. For example, if the former are detained in hospital fifty days on an average, the latter are detained only twenty-five days. The mortality statistics bear out the same principle of greater severity of attack in unvaccinated persons.

Then, again, there is the evidence of protection which is afforded by effectual vaccination and re-vaccination of those who tend the sick. In the epidemic of small-pox which occurred in London in 1901, there was once more the old story of protection for doctors, sanitary inspectors, and nurses who had been vaccinated. In one metropolitan borough all the sanitary staff engaged in dealing with the epidemic were vaccinated except the disinfectors, who declined to be vaccinated, and contracted small-pox as a result. The following figures are even more convincing :—

Of 2,198 persons employed at the metropolitan small-pox hospitals between 1884 and 1900 inclusive, in which period 17,900 small-pox cases were received into the hospitals, only 17 persons contracted small-pox, of whom 13 were not re-vaccinated until after they had joined the ship, and four were workmen who escaped medical observation. Not one of the staff of the hospital ships has ever died of small-pox, and not one has even suffered from the disease for the past eight years. From the year 1881

to the end of 1901 there were employed in the ambulance service of the Metropolitan Asylums Board 1,282 persons. Four of these persons contracted small-pox, of whom one escaped vaccination when appointed—he died; one was unsuccessfully re-vaccinated on joining the service, and the operation was not repeated—she died; the two others had been re-vaccinated and recovered.

Taking all the facts into consideration, the Royal Commission on Vaccination, 1896, concluded that the protection vaccination affords against small-pox may be stated as follows:—

Conclusions of the Royal Commissioners (1896).

"(1) That it diminishes the liability to be attacked by the disease. (2) That it modifies the character of the disease and renders it less fatal and of a less severe type. (3) That the protection it affords against attacks of the disease is greatest during the years immediately succeeding the operation of vaccination. It is impossible to fix with precision the length of this period of highest protection. Though not in all cases the same, if a period is to be fixed it might, we think, fairly be said to cover in general *a period of nine or ten years.* (4) That after the lapse of the period of highest protective potency, the efficacy of vaccination to protect against attack rapidly diminishes, but that it is still considerable in the next quinquennium, and possibly never altogether ceases. (5) That its power to modify the character of the disease is also greatest in the period in which its power to protect from attack is greatest, but that its power thus to modify the disease does not diminish as rapidly as its protective influence against attacks, and its efficacy during the later periods of life to modify the disease is still very considerable. (6) That re-vaccination restores the protection which lapse of time has diminished, but the evidence shows that this protection again diminishes, and that to ensure the highest degree of protection which vaccination can give the operation should be at intervals repeated. (7) That the beneficial effects of vaccination are most experienced by those in whose case it has been most thorough. We think it may be fairly concluded that where *the vaccine matter is inserted in three or four places it is more effectual than when introduced into one or two places only,* and that if the vaccination marks are of an area of half a square inch they indicate a better state of protection than if their area be at all considerably below this."

There remain for brief mention two questions connected with vaccin-

ation. First, does vaccination do any harm? And second, are there any other means of diminishing the prevalence of small-pox.

Is Vaccination Harmful?

The answer to the first question is that, if properly performed with pure calf lymph, there is little or no risk of harm in the operation of vaccination. The four diseases which have been associated with vaccination are erysipelas, blood-poisoning, general vaccinia, and syphilis. The first and last of the four can only be set up in practice by vaccination from human to human. Erysipelas might be conveyed at the time of vaccination owing either to its presence in the lymph employed, or to its being conveyed by the vaccinator himself, or by those with whom the child comes in contact at the time of vaccination. To avoid it, scrupulous care must be taken never to vaccinate, by the arm-to-arm method, with inflamed arms. With regard to syphilis, the same must be said—namely, that absolute freedom from risk can only be had when calf lymph is used. Syphilis is not a disease of the calf. It may be remembered also that though vaccination is enormously increasing, syphilis is steadily declining as a cause of death. Blood-poisoning in greater or less degree is avoided by cleanly vaccination, for it is produced wholly by septic changes set up as a result of unclean vaccine or unclean manipulation. Generalised vaccinia is extremely rare, though in most vaccinations there is, in addition to the local eruption, a slight general febrile disturbance. The safeguards against any complication, however rare, arising in connection with vaccination are (1) to use pure calf lymph only, (2) to adopt absolutely aseptic manipulation, (3) to vaccinate at home, and (4) to vaccinate only healthy children, delaying the operation in all cases of sickness and debility.

Auxiliary Means.

The answer to the second question may be given in a sentence. The means auxiliary to vaccination for diminishing the prevalence of small-pox are (1) measures directed against infection, such as prompt notification, rapid isolation, supervision of those who have been in contact with cases, and disinfection; and (2) measures calculated to prevent overcrowding and promote the public health, cleanliness, sanitation, and the healthy life.

DIPHTHERIA ANTI-TOXIN

The anti-toxin treatment of diphtheria is not an inoculation of disease, nor yet of a weakened virus. It is, therefore, not analogous

to variolation or vaccination. It is an injection of anti-bodies, antagonistic to diphtheria, which have developed in the blood of an animal that has suffered from the disease. In such blood, as we have seen, as a result of the action of the toxin on the blood and body cells, there are produced the counteracting bodies to the toxins, and these are known as anti-toxins.

Different from Vaccination.

To be of value in a case of diphtheria, the anti-toxins must be used early, before there is any tissue change, and before the toxins have got, so to speak, the upper hand. For the same reason they must be used in *large* doses. When the toxins of the patient are on the increase he suffers more and more acutely, and may succumb before there has been time for the formation in his own body of the anti-toxins. If he could, in point of fact, be tided over this crisis all would be well, for then his own anti-toxins would be available. In the meantime, the only way is to inject anti-toxins, *prepared in some other animal* in which the disease began at an earlier date. Such an animal must be one that can stand an attack of diphtheria, and from whose body a considerable amount of blood can be drawn without ill effect. The horse meets these requirements, and it is in its body that diphtheria anti-toxin for human use is now prepared. Such anti-toxin is used as a therapeutic agent in cases of diphtheria, and also as a prophylactic agent in persons who have been in contact with diphtheria infection.

In cases of this disease treated in the hospitals of the Metropolitan Asylums Board, the mortality per cent. has fallen from 30·4 before the days of anti-toxin—that is, in 1890–93—to less than 10.0 When cases are treated with anti-toxin on the first day of the disease, the mortality vanishes altogether ; but if anti-toxin is injected four or more days after commencement, the mortality is still below the average. A similar remarkable decline in diphtheria mortality as a result of the use of anti-toxin has occurred on the Continent of Europe and in America.

Results.

We have now seen that infectious disease may be prevented by various means. We know that the last three or four centuries have witnessed a great reduction in the scourge of epidemic disease and in its mortality. Life is now healthier and longer than it was in the Middle Ages, and with that greater degree of healthiness there is undoubtedly more happi-

ness and brightness, and what a great poet has called "sweetness and light." Much, however, remains to be done, first and foremost by the individual, then by the State acting through the sanitary authority, whose business it is to guard and protect the health of the community. In concluding a consideration of these matters, it may be appropriate to summarise the broad and elementary preventive principles in the four following propositions :—

Summary.

First, the maintenance of a high standard of personal health is the best preventive of disease, especially infectious disease.—The health of a community depends upon the health of every individual. The individual is the unit of the community, and whatever strengthens the unit strengthens the community. This is such an obvious truth that people forget it, and therefore it is ignored. Sir James Paget used to say that "in every day practice *fatigue* has a larger share in the promotion or permission of disease than any other single causal condition you can name"; and particularly is this true if the term fatigue be used to indicate a particular weariness of the bodily organs and tissues as well as a general feeling of tiredness. The overwrought brain, the overfed stomach, the overstrained heart, the unexercised slothful lung, the impure blood, the unclean body—these are the conditions favourable to disease. Yet people will not recognise this, relying instead upon a multitude of artificial means or the uncertain protection of chance. Every man's first contribution to the State to which he belongs should be a healthy body, his own; and this identical contribution is his own best protection against disease. Therefore it is the best prevention of disease, for disease, as we have seen, is a question of seed and soil, and if the soil be healthy and resistant the seeds of disease will not flourish.

Secondly, every man should avoid as far as may be the seeds of disease.—Though we cannot control our ancestors, we can influence posterity by handing on a good hereditary strain. We can control many of the circumstances of infectious disease. We can contract cleanly and hygienic habits, and we can with a little care do much to avoid infection.

Thirdly, the health of a community depends upon the right and prompt treatment of the beginnings of disease.—Take phthisis as an example. Why should one out of every twelve deaths in England be due to this disease? It is a directly preventable malady. We know how

it is caused, we know therefore how it may be prevented, yet all these valuable lives are lost. These people were exposed to an infection to which they ought not to have been exposed, and then, in the second place, they failed to treat rightly and promptly the first beginnings of the disease. *Fresh air* and suitable nutrition were the supreme things needed, whereas in all probability many of these consumptives lived in stuffy homes and relied on medicines. Or take measles, one of the most trifling disorders if rightly and promptly nursed. The children of the rich do not, as a rule, die of measles. Why? Because they are promptly cared for and properly nursed. But everybody knows that the children of the poor do die of measles or of its effects (pneumonia, tuberculosis, etc.). Why? Because they are neglected by ignorant parents, allowed to "catch cold" on top of the measles, and not nursed at the beginning of the disease. Hence from this trifling disease there died in England and Wales in a recent year over 7,000 persons. Or take whooping-cough, another comparatively trifling ailment of childhood. In the same year this was the cause of 9,851 deaths. In some years these two diseases, measles and whooping-cough, kill in England and Wales more persons than small-pox, scarlet fever, influenza, typhoid fever, and diphtheria *all added together*. If we take bronchitis and pneumonia, much the same story must be told. Surely it is because of negligence or want of careful nursing at the *beginning* of the illness that these diseases kill so many. The child "caught a cold," and the cold was neglected, and bronchitis or pneumonia supervened, and the child died. And thus we might continue to illustrate the simple but important truth that disease in the individual and in the community is prevented by resisting the beginnings. If the beginnings were controlled, epidemics would rarely happen.

Fourthly, the chief work of a sanitary authority is to deal with broad, commonsense requirements.—In these days of the marvellous progress of science we are liable to the error of overstepping the bounds of commonsense and experience. Bacteriology is a new science which has rapidly advanced, and by which our knowledge of the causes of disease has been greatly increased. But let us not draw absurd or unwarrantable conclusions from a science which is in its infancy, and some of the findings of which yet require further confirmation. We can, it is true, now diagnose certain diseases by discovering the presence of certain bacilli, and we can prevent and diminish certain diseases by

inoculating anti-toxins. We know also that milk, water, oysters, etc., contain bacteria and may on occasion contain injurious and dangerous bacteria. But the chief work of sanitary authorities is to furnish, on broad lines, a healthy environment for the members of a community rather than to follow minutely the niceties of bacteriology, valuable though that science is. Bacteriology points the way of advance and detects dangers otherwise unforeseen, but it is necessary for sanitary authorities to judge their work on broad grounds, not asking from science more than it can render, and not following science blindly in letter rather than in spirit.

For example, dirty milk should not be sold, even if the number of bacteria in it be small; cows should be stabled in clean cowsheds, and not used for dairy purposes if suffering from disease; cleanliness throughout the whole process of dairying is vastly more desirable than sterilisation and pasteurisation of dirty milk. Again, it is wiser to obtain water from clean gathering grounds than to filter and purify water from dirty gathering grounds, although in practice filtration is necessary as a further protection. Or, again, whatever bacteria may or may not be found in oysters and shell-fish for human consumption, these molluscs should not be grown on polluted beds. Oyster beds and sewage outfalls should be things apart. And so we might continue to illustrate the proposition that in the main the work of sanitary authorities is to furnish the broad necessities of healthy life for all persons within their community. Fresh air unpolluted by smoke and dust; pure food, pure milk, pure water—each of them sold unadulterated and without prejudice or injury to the purchaser; clean streets and houses; sanitary house and school accommodation; healthy workshops and workplaces; the prompt removal of refuse and sewage; the effectual separation of diseased persons from the healthy in order to diminish the chances of infection; the investigation and prevention of disease; the postponement of the event of death—these are the true lines of policy for every sanitary authority, a policy which stands, it is true, on science, but also on commonsense and human experience. It is broad and simple, *but it is essential.* The highest welfare of the community—indeed, its very life—depends in no small measure upon the efficiency of public health work. Whatever else is neglected or left undone, sanitary authorities cannot afford to neglect to provide the primary requisites of healthy physical life. Nor, we must

once more insist, writing as we are for the public at large rather than for local authorities, can individuals afford to neglect their own personal health. It is with the healthy bodies and minds of the people in local communities that the State is built. The business of securing and maintaining health of the individual or of the community is therefore not a small or ignoble concern, and to make it depend upon party opinions, or vested interests, or chance, is the height of folly, and indeed worse than folly. Its ideal should be to extend in all directions, for all men, the frontier of life.

CHAPTER XCIX

PUBLIC HEALTH (*continued*): DISPOSAL OF THE DEAD

The Six Ways of Disposing of the Dead—City Cemeteries—Reasons why Burial Grounds should not be close to Dwelling-houses—Four Essentials in the Provision of Burial Grounds—Cremation—The Golder's Green Crematorium Described.

PART of the scheme of prevention of disease is the suitable and safe disposal of the bodies of the dead. There are approximately 1,500 deaths in England and Wales every day. The disposal of this large number of dead (many of whom have died of infectious diseases) in such a way as to avoid danger to the living is a sanitary problem of great importance. There is danger, of course, from infection from the unburied body; there is also danger from overcrowded or badly situated graveyards. Both dangers must be carefully guarded against.

Methods of Disposing of the Dead.

There are at least six ways in which man disposes of his dead. Some of the most primitive races of men adopt the method of the animal creation, and simply leave the dead body in the open air. In the course of time, as we know, it disappears, and even the white bleached bones vanish. The Parsee places the dead body on his Towers of Silence, where it is devoured by vultures. Many of the religious races of Northern India commit the corpse to the holy waters of the sacred Ganges. The Egyptian from time immemorial has attempted to preserve the remains of the dead by embalming and safe sealing in stone or metal tombs. Then there is the ancient method of burial, and there is cremation.

The final analysis of all these six methods is the same; the material parts of the body, as of all vegetable and animal life, return to mother earth, and become eventually, directly or indirectly, assimilated with the tissues of new forms of life. Therefore it cannot be disputed that what is wanted is the rapid and complete absorption of the body

by the soil. The soil contains, as we know, millions of microbes whose business it is to aid in the economy of Nature by breaking down animal matter into its simplest elements (*denitrification* and *decomposition bacteria*), and then building up those elements into oxidised compounds useful in the carrying-on of natural processes (*nitrification bacteria*). Nature wastes nothing. Sooner or later all animal matter is thus resolved into its elements and reconstructed in nature. To hasten and control that process should be the object of those whose duty it is safely to dispose of the dead. The route may be longer or shorter, but the destiny is the same. The more the matter is considered, the more support will be forthcoming for speedy resolution.

City Cemeteries.

The condition of our great city cemeteries is well known to be of such a character as can hardly fail to be not only non-æsthetic, but also repulsive. Many of them are triumphs of scientific grave-digging. They are enormously overcrowded, and they are situated in too close proximity to the dwelling-houses of the living. The Royal Commission on Burial Grounds in 1840 disclosed a serious state of things in this relation, and many of the central London cemeteries were absolutely closed as a consequence. But this solution of the problem was only of the character of a postponement, and many new suburban cemeteries are now rapidly becoming surrounded by the ever widening city, and thus the problem is being recreated.

The Dead too Near the Living.

This proximity of the dead in burial grounds to the living in the dwelling-house is disadvantageous, apart from any æsthetic disadvantage, for two chief reasons. In the first place, there is the general unhealthy effect on the soil of too great a burden of dead organic matter, a burden beyond the assimilative powers of the soil ; in the second place, there is the danger which may arise from re-infection. Darwin showed that about three inches of the superficial mould of soil are brought from below by earthworms in every fifteen years. The worms swallow the earthy matter of soil, digesting what is digestible, and casting what is indigestible. In such casts Pasteur was able to demonstrate the presence of microbes with which experimental soil had been seeded. We know, too, that the spores of the bacilli of some diseases—as, for example, anthrax—may remain in soil many months and even years, retaining their vitality and even their virulent properties. Moreover, it is known that several of the germs which produce disease in man are capable of existing

in soil. Thus it comes about that modern bacteriology has demonstrated that the soil may act as a medium for the retention, and certainly among animals for the propagation, of diseases fatal to man.

Both these points, therefore, call for consideration—namely, the heavy pollution of the soil of graveyards with the accompanying risk of contamination of both air and water, and the actual infection of the soil even to its surface with germs which had found refuge in the bodies of the dead, and were possibly even the cause of death. It is on account of such facts as these, in addition to the creation of gross nuisances which from time to time arise in connection with overcrowded burial grounds, that certain restrictions become necessary. Without entering into these in detail, we may say that the four chief sanitary considerations to be held in view in the provision of burial grounds are (1) suitable open, porous soil and proper elevation of site in order to obtain proper drainage and purification of the soil by gravity; (2) a suitable position, especially with respect to houses (100 yards distance) and sources of water supply; (3) sufficient space per "population" (1 acre per 1,000 for 50 years) to avoid the gross degree of overcrowding which existed prior to 1840; and (4) proper regulation and management. Brick graves, vaults, catacombs, heavy oak coffins, and most of all lead coffins, are objectionable, and represent a futile attempt to prevent decomposition. Perishable coffins of wicker, light wood, or even *papier mâché*, are most suitable of all. At the time of the Plague we know that the dead were buried outside the gates of the City of London in "plague pits." In these pits were placed the uncoffined bodies of those who died in such large numbers and so rapidly that there was no time either to make coffins or to perform religious ceremony. Such plague pits are not infrequently met with even to-day, when deep excavations are being made for laying foundations for new buildings on the City boundary. Graves of this sort have at least one advantage—that Nature is able to do her work more completely and with better and sweeter effect than in the old leaden coffins and stone graves of the same period which are met with in similar excavations.

Four Essentials.

It should perhaps be added that the removal of human remains from one burial ground to another under circumstances of excavation or otherwise is only permitted by licence of the Home Secretary if from unconsecrated ground, and by a faculty of the Bishop if from

CHAPEL OF THE GOLDER'S GREEN CREMATORIUM.

ON THE RIGHT IS SEEN THE CATAFALQUE FROM WHICH THE COFFIN IS PASSED INTO THE INCINERATING CHAMBER.

consecrated ground, and in either case the removal must be conducted with due order and decency.

It was chiefly on medical grounds and by the influence of Sir Henry Thompson, the eminent surgeon, that cremation began to be practised in England in the early 'seventies of last century. Cremation was a very early and very widespread usage. Indeed, it was not until the Christian era that the practice was gradually suppressed. It is now being re-introduced, partly owing to the movement originated in England in 1874 by members of the medical profession. In 1884, by a judgment of Mr. Justice Stephen, cremation became a legal procedure, and the Cremation Society at once set to work to carry out its ideal. In 1894 the number of cremations in this country was about 130. In 1911 it reached 1,023, and it continues to grow. In a crematorium a body of average weight is reduced to about 3 lb. of inorganic ash within one or two hours. In 1902 the Cremation Act was passed empowering burial authorities to provide and maintain crematoria, the plans and site being approved by the Local Government Board, and the Home Office being responsible for maintenance, inspection, forms of notification and declaration, certificates, etc. A medical certificate signed by two medical men is necessary, one of whom must have attended the patient. No crematorium may be built within 50 yards of a roadway or within 200 yards of a dwelling-house, except by consent of the owner. There are now in England thirteen crematoria, of which no fewer than six —at Hull, Leicester, Leeds, Bradford, Sheffield, and London (Ilford)— are owned or controlled by the municipality. In Italy there are some twenty-four, while America possesses somewhere about forty. The well-known Golder's Green crematorium, which may be taken as typical and occupies twelve acres on the border of Hampstead Heath, has been described by Dr. E. W. Lowry in the following words :—

Cremation.

"The building, which comprises a chapel, cloister, and columbarium, is dignified through the very simplicity and solidity of its design. The chapel, which seats 300 people, has a raftered roof, a rose window, and fine oak-panelled walls and organ case. The catafalque, upon which the coffin rests during the service, consists of a massive bronze table standing before an arch of marble, in which is a gate of beaten bronze, leading to the furnace beyond. Over the gate are graven the words 'Mors janua vitæ est.'

"The coffin is laid upon this table by the undertakers, and remains

upon it until the conclusion of the service, when the gate is mechanically raised, and it glides upon an endless chain out of sight and into the incinerating chamber. Two objects are thus gained; neither coffin nor corpse is touched by hand from the moment they are deposited in the chapel, and no part of the actual burning is seen or can be seen by the friends. The furnace, which is of the reverberating type, subjects the body to a temperature of over 2,000° Fahr., and from it all volatile gases are drawn on through a subsidiary fire so efficient that not even smoke is visible at the top of the chimney shaft. Complete incineration occupies eighty minutes, and reduces the body to ashes and gas. The former resemble coarse white sugar, and amount to 3 per cent. of the total body weight. The remaining 97 per cent. is liberated in the form of invisible gas, largely CO_2, from the top of the chimney. The most elementary botany teaches that CO_2 is seized upon by the stomata of plants, which fix the carbon for their own use, and set free the oxygen for the service of man and his fellow-animals.

"Thus the carbon and oxygen, which formed part of the old dead body, are again within a few short hours integral parts of new bodies, fulfilling their eternal destiny in a universe wherein nothing is outworn and nothing is unworn, yet wherein all things shall become new. Thus the elements which Nature demands for the support of new forms of animal and vegetable life are yielded back to her, that her great cycle of life may be kept up by constant interchange between the two kingdoms of life.

"The ashes, the solid 3 per cent., are handed, in a terra-cotta casket, to the friend who remains to receive them. This urn can be buried in any graveyard, or deposited in any church, or placed in a niche in the handsome columbarium, the burial service of any sect being read over it. In this way the new cremation renders possible the family vault in the parish church, which has been illegal since 1840, and not only renders it possible and legal, but also renders it safe.

"Cremation interferes with no religious rite, but admits of the same ceremonial as ordinary burial, for the chapel is available for any service, religious or secular."

The only logical physical objection which can be urged against cremation is that it destroys evidence as to the cause of death, but this is a question not of method of disposal of the dead, but of death certification, which can be, and ought to be, so restricted and checked as to avoid all risk of interfering with the course of justice.

FIRST GALLERY OF THE COLUMBARIUM
AT THE GOLDER'S GREEN CREMATORIUM.
(IN THE NICHES THE CINERARY URNS ARE DEPOSITED.)

CHAPTER C

PUBLIC HEALTH (*concluded*): SOME CAUSES OF NATIONAL INEFFICIENCY

Alcoholism—Poverty—Overcrowding: Hampstead Compared with Southwark; Lessons from Finsbury—Dangerous Occupations—A Filthy and Dangerous Habit.

INTIMATELY connected with the creation and maintenance of a high standard of public and personal health there are a variety of questions not usually associated with the subject before us. Alcoholism, poverty, overcrowding, dangerous occupations, habits and customs, hours of labour, and many kindred matters are all factors which may play a great part in health. They are as intimately bound up with it as is a sanitary environment, and in many ways exert a more powerful influence. It is proposed, therefore, in the present chapter briefly to refer to the way in which these factors operate.

Alcoholism.

The excessive drinking of alcohol is well known to produce many evils. "In alcoholism," says Dr. Newsholme, "we have to deal with a chief cause of national inefficiency." In the first place it is one of the chief causes of poverty, and so leads to obvious conditions of ill-health. Then there are the indirect influences which it exerts by altering the character and customs of persons addicted to it. Fathers and mothers who are alcoholics maltreat their children. It cannot be doubted that not a few of the deaths of infants are due to mismanagement by alcoholic mothers. Many accidents also, in almost all outdoor occupations, occur as the result of intemperance. In the construction of great engineering works—as, for example, the building of the Forth Bridge—the admissions to hospital for minor accidents on Mondays have been shown to be, as a rule, greatly in excess of those for any other day of the week, and their origin has been frequently traceable to alcohol drinking. Much disease is also due to the same

cause, including not a little insanity, all the "alcoholism" (about 2,000 deaths per annum in England and Wales), some of the cirrhosis of the liver (about 4,000 deaths per annum), some gastric diseases, some nervous diseases, and some of the tuberculosis. There is evidence in the reports of the Registrar-General that the death-rate per million from alcoholism pure and simple is increasing, which, after all allowance is made for certification and improved diagnosis, indicates that there is an increasing amount of mortality from alcoholic disease, particularly among women. Lastly, it must not be forgotten that alcoholism incapacitates even more than it kills.

Poverty.

Poverty, if of such degree that physical efficiency cannot be maintained, shows itself in (*a*) a higher death-rate, (*b*) a higher infant mortality rate, and (*c*) a lower physical standard, both in physique and in health. These results come from poor nutrition, insufficiency and unsuitability of food, particularly among women and girls of the very poorest classes. The diet of the Edinburgh working-man was found, on investigation, to be some 10 to 15 per cent. below the average standard of his class. Of course, in addition to lack of good food, there are, as a result of poverty, many other limitations, such as bad housing, insufficient firing in winter, insufficient clothing, strain, dirt, fatigue, etc., all of which have an evil influence on health.

Over-crowding.

Overcrowding, again, exerts what has been called a "soul-destroying" effect. It means, of course, lack of space, ill ventilation, the herding of people together in confined rooms. This leads to shortness of days, as has been pointed out by Sir Shirley Murphy, the late medical officer for the County of London, who has compared "the expectation of life" in Hampstead, where there is little overcrowding, with that in Southwark, where there is much. In Hampstead the expectation of life at birth is fifty years compared with only thirty-six in Southwark. Then there is a higher mortality in overcrowded areas, not only generally, but also particularly in infectious diseases and in consumption. Sir George Newman, while medical officer of Finsbury, showed the effect of living in small and overcrowded tenements in a series of tables from year to year, of which an abstract is given on page 305.

From that table we see how high is the death-rate among persons living in one-room homes—that is, under overcrowded conditions as a rule and compared with others. Every year tells the same story ; and

DEATH-RATES FROM ALL AND CERTAIN CAUSES IN HOUSES OR TENEMENTS OF SEVERAL SIZES IN FINSBURY, 1903 TO 1906.

Size of Tenements	*Census Population* 1901, 101,463*	*Death-rates per* 1,000 *from all Causes*				*Death-rates per* 1,000 *from Infectious Diseases*				*Death-rates per* 1,000 *from Phthisis*			
		1903	1904	1905	1906	1903	1904	1905	1906	1903	1904	1905	1906
One-room tenement ..	14,516	38·9	40·6	32·7	39·0	5·6	5·1	3·4	6·4	4·5	4·5	3·5	3·4
Two-room tenement ..	31,482	22·6	21·9	19·5	22·5	3·8	4·1	2·8	5·5	2·8	2·2	2·1	2·3
Three-room tenement ..	21,280	11·7	14·7	12·3	14·8	1·8	2·1	1·8	2·6	1·2	2·3	1·3	1·4
Four-room tenement and upwards of four rooms ..	33,185	5·6	7·5	6·6	6·4	0·54	0·1	0·69	0·8	0·63	1·2	0·81	0·93
Institutions†	1,000	16·0	28·0	8·0	33·0	..	..	..	3·0	7·0	5·0	..	14·0
Deaths not traced ‡ ..	..	273	216	268	185	12	11	18	22	13	25	28	38
The Borough Death-rates	..	19·8	21·1	18·9	20·7	2·6	2·8	2·06	3·7	2·2	2·5	2·1	2·3

* For the purposes of this table it was necessary to use the census population (1901), for all four of the years included in the table. It should not, however, be forgotten that the population is declining, and the death-rates for each year in this table are, therefore, approximate only. In 1912 the population was only about 88,000.

† Institutions include common lodging-houses, houseless poor asylum, house of retreat, and similar institutions (excluding, of course, hospitals, infirmaries, etc.). The population is stated approximately only.

‡ These are *deaths* (not death-rates) returned as belonging to Finsbury, in which no address was furnished, or the deaths were not traceable at the addresses furnished, or for special reasons the deaths were not visited.

although, as Sir George Newman pointed out in his reports, there are certain reservations to be made, the broad fact is evident that the death-rate is higher the more limited is the home accommodation. In 1906 Sir George also measured the effect of overcrowding, etc., by distributing the death-rates of Finsbury into the seventy enumeration areas used by the census authorities, and he found that in fourteen of the seventy sub-districts of Finsbury the death-rate was above 25 per 1,000, though the death-rate for the whole borough was only 20·7 per 1,000. The characteristics of these fourteen high mortality areas were found to be as follows :—

" First, there is *a high density of houses per acre.* The areas are covered densely with dwelling-house property, with narrow streets and small back yards and without open spaces. Secondly, the high mortality areas have *a high percentage of poor-class tenement houses,* which have in the main degenerated from better days, and are now the home of much domestic insanitation of every description. These houses, built for one family and now inhabited by six or eight families, are most inconvenient and unsatisfactory, and though perhaps not overcrowded according to the bye-laws, are in fact overcrowded from the point of view of personal and public hygiene. Thirdly, these areas have a *high percentage of poverty.* The persons living in them are engaged in casual occupations—carmen, labourers, etc.—and their average wages are from 15s. to 25s. per week. Rents average about 2s. 6d. to 3s. per room. Lastly, it must be said that in these areas rather more than elsewhere, and perhaps largely because of the above-named conditions, there is *a low standard of social life.* Many of the inhabitants of these areas are ' birds of passage,' drifting from one poor district to another, above the average in age but below it in health, in nourishment, and in stamina, and below it often in social responsibility and in social habit and custom. And thus it comes about that they are the most susceptible to disease and the least able to throw it off. A high percentage of them die in institutions.

" Eleven areas yield a death-rate below 15 per 1,000, and may thus be classed as exceptionally healthy. In such areas there are less density, fewer tenement houses, better wages, and a higher standard of social life."

In addition to producing shortened days, overcrowding also causes the spread of infectious disease. Sir Shirley Murphy has shown that the phthisis death-rate is much greater in overcrowded areas, and the same might readily be demonstrated for all infectious diseases.

Dangerous occupations are another factor which in some industrial districts plays a great part in health. The dangerous trades are those

processes in which the worker is in danger of injury to himself from the industry. Among such trades are certain chemical trades, mining, electric work, knife grinding, lead working, water-gilding, potteries, silvering trades, match-making, and so on. From these sources men may acquire lead poisoning, "phossy jaw," poisoning by arsenic and mercury, and even organic infections like anthrax and tetanus. Closely associated with dangerous trades are the questions of factory labour, long hours, unhealthy workshops, etc. Much has been done under the Factory and Workshop Act to ameliorate the condition of the worker from a health point of view. This Act provides for cleanliness, air space, ventilation, drainage of floors, and suitable and sufficient sanitary accommodation. It requires also regulation of home-work, sanitation of bakehouses, inspection and registration of all work-places, and the notification of cases of poisoning.

Dangerous Occupations.

Lastly, there are habits and customs of the people which directly affect the health of communities. One instance, and that a very marked one, will suffice to illustrate the importance of the matter—namely, the habit of spitting. Apart from the fact that this habit is objectionable and inelegant, it will be remembered that when tuberculosis was under consideration we pointed out that this disease when it affects the lungs is largely spread by expectoration. The tubercle bacillus is thus voided from the body, and when the sputum dries is widely disseminated. There can be no doubt that this is one of the chief ways in which the disease is spread. The International Congress on Tuberculosis, held in London in 1901, definitely declared that the suppression of the habit of spitting was one of the most important means of prevention. The London County Council passed a bye-law prohibiting spitting in public places, and many county councils have adopted similar measures. Companies and corporations have followed this excellent example, and have affixed notices to their premises or public carriages advising against this habit. Everyone who works towards this end is aiding in a public health measure of first importance.

Habit of Spitting.

CHAPTER CI

HEALTHY HOMES: SITE AND STRUCTURE

Site—Soil—Aspect—Prospect—Open Space Around the Building—Foundations—Damp Courses—Walls—Bricks—Mortar—Roofs—Floors—Internal Surface of the Walls—Ceiling.

Crescent and street and square I build,
Plaster and paint and carve and gild.
Around the city see them stand,
These triumphs of my shaking hand,
With bulging walls, with sinking floors,
With shut, impracticable doors,
Fickle and frail in every part,
And rotten to their inmost heart.
There shall the simple tenant find
Death in the falling window-blind,
Death in the pipe, death in the faucit,
Death in the deadly watercloset !
A day is set for all to die :
Caveat emptor ! what care I ?

R. L. Stevenson (" *The Builder's Doom* ").

In 1820, when Deacon Thin, the jerry-builder whose exploits are commemorated by Stevenson in the ballad from which the above extract is taken, built his houses of lath and plaster, the science of hygiene was but little understood, and houses were designed and built with small consideration for the health of the tenants who were to occupy them. But we are fortunate enough to live at a time when much has been learnt about the causes and prevention of disease, and when the knowledge has been applied in numerous Public Health Acts to raise the sanitary standard of building construction. And the result of this has been that although the conditions of modern life have brought about a great and increasing urbanisation of the population, we can still live healthily, in spite of the many evil influences of town life. The death-

rate has steadily fallen, and London, once a hotbed of disease, has now become one of the healthiest of cities. In fact, it not unfrequently happens that town dwellers who have been holiday-making in search of health at some picturesque but insanitary farmhouse or other rural habitation, return to their homes bringing infectious disease with them. Every autumn a number of cases of typhoid fever are imported to London in this way, the patients having picked up the deadly germs in some rural region where the district councillors are much too considerate to worry their neighbours with such matters as sanitary inspection.

In this and the next chapter we shall set forth the conditions that go to make a healthy home. It is, of course, not to be expected that all these conditions can be fulfilled in every home. Few persons can live

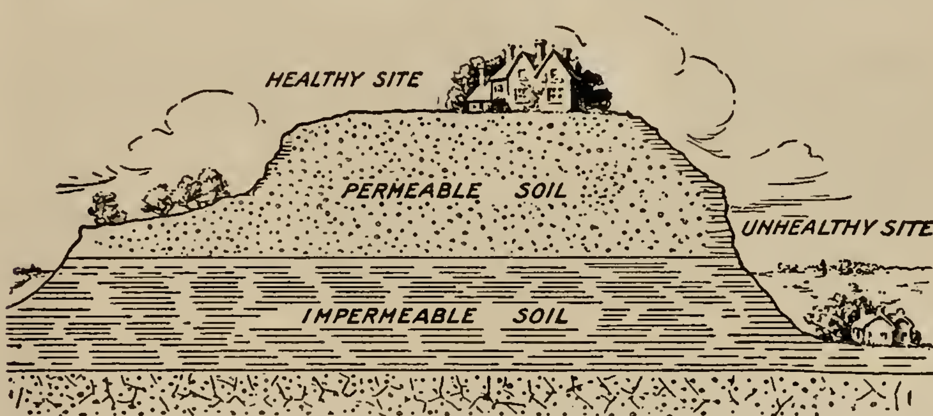

Fig. 114.—Healthy and Unhealthy Site.

just where they like. Most of us have to earn a living at some particular place, which is selected for reasons other than those of health, and our choice of a home is dependent on that. The important matter of rent has also to be considered. On the other hand, the great development of electric trams and other means of locomotion has considerably extended the area over which the house-hunter may roam, and in any case it is well to know what the requirements of a healthy home are, even if it should be found impossible to secure every one of them.

SITE

The site of a house is a very important matter. "He that builds a fine house on an ill site," remarks Bacon, "committeth himself to prison." An elevated position is to be preferred. The popular feeling against dwellings that lie low as being unhealthy is amply justified.

Alluvial tracts should be avoided. A house that stands high gets more sunshine and fresher air than one that lies at the bottom of a valley; its position favours free drainage of both surface water and subsoil water, and it will therefore be less likely to be damp. The site should be somewhat sheltered from the north and east, but not in such a way as to make the house "shut in," and the ground immediately round the house should slope from it on all sides.

SOIL

The character of the soil upon which the house is built has an important bearing on the health of the inmates, although modern improvements in building construction have to some extent minimised the disadvantages of the less suitable soils. From a hygienic point of view building soils may be divided into two main classes—the permeable and the impermeable, the former comprising the sands and gravels, the latter the granites, hard limestones, and dense clays. It is generally agreed that the more porous soils are the more healthy, but it must not be forgotten that they are also readily polluted by leaky drains, cesspits, etc., and that the pollution may extend for a considerable distance.

Permeable and Impermeable.

In all permeable soils, if we dig far enough, we shall come sooner or later to a point where all the interstices of the soil are filled with water. We have then reached the level of the ground water or subsoil water. The ground water is derived from the rain, which percolates through the soil until it reaches a layer that is sufficiently impermeable to prevent any further downward penetration. The level of the ground water varies considerably. In marshy localities it may be as high as the surface of the ground, and under ordinary conditions it may vary from about 2 feet to well over 100 feet in depth. In low-lying districts it is usually close to the surface of the earth. The ground water is in constant movement, both vertically and laterally. It flows laterally, with a velocity that varies with the slope of the underlying gradient and the permeability of the soil, to the nearest watercourse, or to the sea, or to fissures in the rocks, shafts of mines, springs, or other outlets. The level of the ground water is constantly changing; it reaches its highest point in times of heavy rainfall, and its lowest in times of drought. The range of rise and fall may not exceed a few inches, but is generally several feet.

Ground Water.

Above the level of the ground water, the interstices of the soil are filled with air, the ground air, which is kept moist by evaporation from the surface of the ground water, by capillary attraction, by the movements of the ground water, and by rainfall. The amount of moisture in the ground air depends on the level of the ground water. If the water level is not more than a few feet below the surface of the earth, the ground air is saturated with moisture. As the ground water rises, air is forced out from the surface of the earth, and when the ground water falls air is drawn into the earth by atmospheric pressure, to be again expelled with the next rise in the water. Thus, in a sense, the surface of the earth may be said to breathe; it is constantly inspiring and expiring air.

Ground Air.

Sanitarians attach considerable importance to the rise and fall of the ground water. As it rises it tends to wash polluted matter from the soil into walls, and to force ground air into houses that are not protected by proper foundations. When it falls it leaves the soil moist and aërated—a condition of things that greatly favours putrefaction. The chief importance of the ground water, however, lies in its influence on ground air. If the level of the ground water is not more than 5 feet or so from the surface of the earth, the ground air is damp and cold, and the site, therefore, unhealthy. In building sites the ground air should be dry. Damp sites predispose to rheumatism, bronchitis, neuralgia, catarrhs of various kinds, diphtheria, measles, and whooping-cough. Dampness conduces, moreover, to consumption. Dr. Buchanan in England and Dr. Bowditch in America have shown by an extensive study of the local variations of consumption that the death-rate from this disease has a close relation to dampness of subsoil. These observers found that in districts where the ground water had been lowered, and the subsoil consequently dried, by artificial drainage, the mortality from consumption had fallen 30 and in some cases 50 per cent. In a healthy building site the level of the ground water should be at least 15 feet from the surface of the earth, and if necessary that level should be maintained by subsoil drainage. This may be effected by "agricultural" pipes—*i.e.* unglazed earthenware pipes laid with open joints or perforated in order freely to admit water along the whole length of the drain. These pipes are laid in a trench, broken stones or pebbles being placed on them to prevent the openings in the pipes from being stopped up with earth. Subsoil drainage, even though it may in certain

circumstances be unable to maintain the ground water at a permanent low level, should at all events prevent great fluctuations of level, which alone is a considerable advantage.

"Made Soils."

Ground air in a healthy building site, besides being dry, should also be free from impurity. For this reason, among others, "made soils" should never be used for building purposes. Made soils are collections of house refuse or other kinds of rubbish which are often formed by filling in excavations made by removing gravel. In many of our industrial centres refuse "tips" of this kind have been used as building land. It is obvious that on such sites the ground air must be grossly polluted, and under no circumstances should they be used for building purposes.

ASPECT

In a climate which, like that of our own country, is not too rich in sunshine, the house should be so placed as to receive the maximum amount of sun. Direct sunlight is a powerful disinfectant; and if a

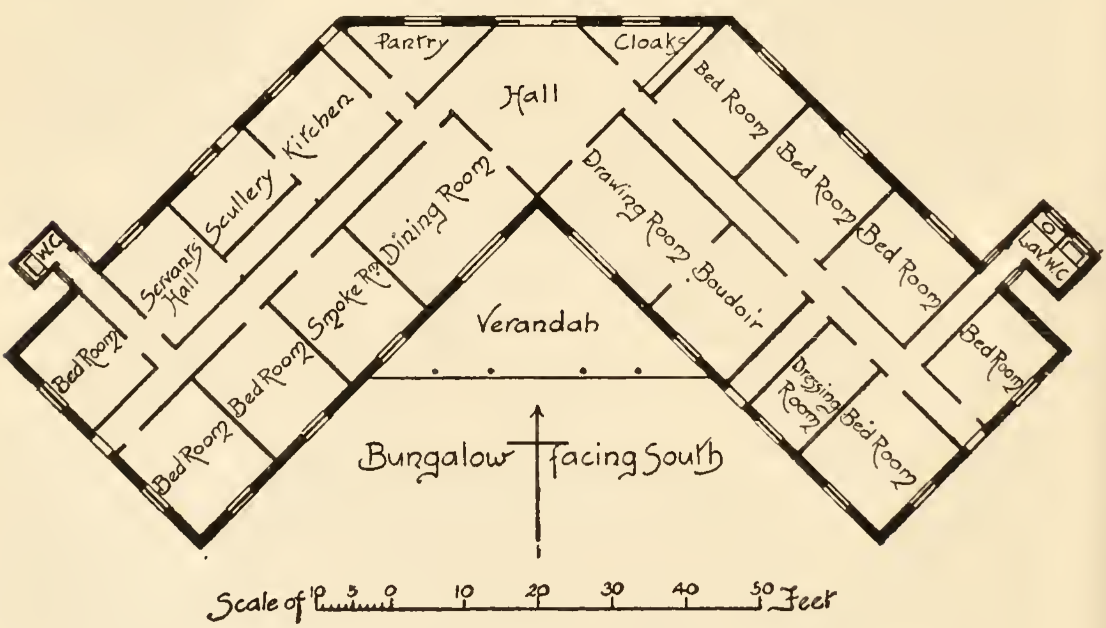

Fig. 115.—A "SUNTRAP."

(From "The Dwelling House," by permission of Messrs. Longmans, Green & Co.)

house is well exposed to the sun the expense of keeping it warm will be considerably lessened. The chief rooms in the house should face the south-east. The inmates would then enjoy the morning sun. The

kitchen, scullery, larder, lavatories, boxroom, etc., should be placed on the north side. The bathroom should, of course, face the south-east. There is much to be said for Dr. Vivian Poore's suggestion that a house should be built so that the ground plan would form a right-angled triangle, with the apex pointing to the north. Such a house, as Dr. Poore points out, would be a veritable "suntrap." "The sun, even on the shortest day, would, if visible, shine into the angle for over seven hours continuously. In this re-entrant angle there would be complete protection from northerly and easterly winds; and if provided with a glass covered verandah, it would be possible for even the most delicate invalids to enjoy in it a maximum amount of air. The problem in such a house would be not how to keep warm in the winter, but rather how to keep cool in July."

"Suntraps."

PROSPECT

Another important consideration is that of prospect. A pleasant prospect conduces to health, for the mind has a considerable influence on the body, and the tired nerves of the brain-worker find recuperation in the contemplation of natural beauty. Stevenson has some wise remarks on this subject in his delightful essay, "The Ideal House," which the reader, if he be wise, will read at the first opportunity.

But a pleasant prospect is a thing unattainable by the average English town-dweller, who, in the vast majority of cases, has to be content with a view of the houses on the other side of the street. The modern English suburb is badly off for pleasant prospects. It consists of streets of small featureless red-brick houses, all of which are exactly alike, and there is an absence of the trees that form so pleasing a feature of many Continental towns. Although England in its rural districts is the most richly wooded of countries, there is no country whose towns are so poorly provided with trees. Now that we have become a nation of town-dwellers, it is important that we should bestir ourselves to make our surroundings as pleasant as possible, and to provide some more cheerful domestic prospect than that afforded by the suburban street with its dreary macadam carriageways and flagged footways, its depressing sameness and meanness of architectural design, and its lack of foliage. Fortunately there are signs of improvement. The Garden City movement has shown what can be done to make towns agreeable places to live in. The systematic planning of towns and suburbs to

secure pleasant streets and open spaces, and a healthy arrangement of houses, is now being undertaken with enthusiasm in various parts of the world. There are now quite a number of town planning schemes in operation, and we may hope that the suburbs of the future will resemble Bournville, Mr. Cadbury's garden city near Birmingham, rather than the squalid wildernesses of houses with which we are too familiar.

Town Planning.

OPEN SPACE AROUND THE BUILDING

This is a matter that has been much neglected in the past. In towns, where building land is relatively valuable, there is a tendency to crowd the buildings together and so reduce the open space to a minimum. In the days before building regulations it was a common practice to house the poor in courts, which were usually narrow *culs-de-sac* entered through a little passage overarched by a portion of a house fronting upon the street. In such courts the air was practically stagnant. There are many courts of this kind still to be seen in our older towns. Another insanitary practice that was formerly much in vogue was the erection of back-to-back houses, and in some of our manufacturing towns these may still be found in large numbers. In such houses through ventilation is, of course, impossible, and it is not surprising to find that the inmates of back-to-back houses suffer from consumption and other diseases. Some years ago the question of the unhealthiness of back-to-back houses was thoroughly investigated, and some striking statistics were obtained. It was found, for instance, that in a certain district of Salford, a district occupied by the poorest classes of the population, the death-rate in the different parts of the district bore a close relation to the proportion of back-to-back houses. This district was divided into three parts, according to the proportion of back-to-back houses in each part, and it was found that the death-rate in the part with no back-to-back houses was 27·5 per 1,000 population, as against a death-rate of 29·2 in the part where the proportion of back-to-back houses was 23 per cent., and a death-rate of 39·5 in the part where the proportion was 56 per cent. The zymotic death-rate, and the death-rates from consumption and diarrhœa, showed similar variations. The class of population and the average surroundings were the same in each district.

Back-to-back Houses.

The building of back-to-back houses is now prohibited by law, and

a minimum of open space is required around dwelling-houses. In London, the County Council is empowered under the London Building Act, 1894, to refuse to sanction the formation of streets for carriage traffic of less width than 40 feet clear, and streets formed for foot traffic only must be at least 20 feet in width. In some cases streets that are outside a 2-miles radius from St. Paul's may be required to be not less than 60 feet wide. The London Building Act also provides that a domestic building that abuts on a new street must have at the rear an open space of at least 150 square feet, extending thoughout its entire width and at least 10 feet across in every part. Where, however, the storey on the ground floor is used for business purposes, or is for other reasons not inhabited as a dwelling, the open space of 150 square feet may be provided above the level of the ceiling of the ground storey, and the ground at the rear may be built upon, provided the building be not more than one storey high. It is regrettable that any exemption was made from the rule that requires an open space at ground level, but this was thought necessary in view of the high price of building land in London.

It must not be forgotten that the above regulations as to open space round buildings represent the minimum requirements in a city where the price of land is enormously high; in country districts the householder should endeavour to obtain much more breathing room round his dwelling.

FOUNDATIONS

The object of the foundations is to prevent the walls from sinking and forming "settlements." Settlements may be suspected when there are cracks in the walls, or when the windows and doors stick, or when locks, bolts, latches or other fastenings of doors and windows fail to work properly. But in laying the foundations it is necessary also to take certain precautions to prevent foul air and damp from entering the house. The importance of this has already been explained in describing the ground air, and, as was pointed out, it may be necessary before beginning to lay the foundations that the site should be subjected to some preliminary treatment. If the level of the ground water is high or subject to considerable fluctuation, the site should be drained by a properly constructed subsoil drain, which must discharge into an open watercourse, or over a trapped gully that is disconnected from the ordinary house drains. If the site is "made

ground," formed by the deposit of house refuse, road sweepings, or other foul matter, or if it is much polluted from any source, the polluted matter should be excavated and removed.

To Prevent Ground Air from Rising.

But in any case, it is necessary to take further precautions to prevent the ground air from rising into the house. The air inside a house is considerably warmer than the ground, and therefore there is a constant tendency for air to be sucked in through the floor from the ground below the house. This action is greatly aided by the fires in the house, which exercise a powerful aspirating effect on the ground air. The whole of the site should, therefore, be covered with an impervious substance, such as concrete or asphalte. Concrete is usually employed for this purpose. It should be not less than 6 inches thick in every part, and should be covered with cement to make a smooth surface. It is advisable also to run a layer of asphalte over the concrete. This is very effective in resisting the entrance of damp, and it makes a good floor for a basement.

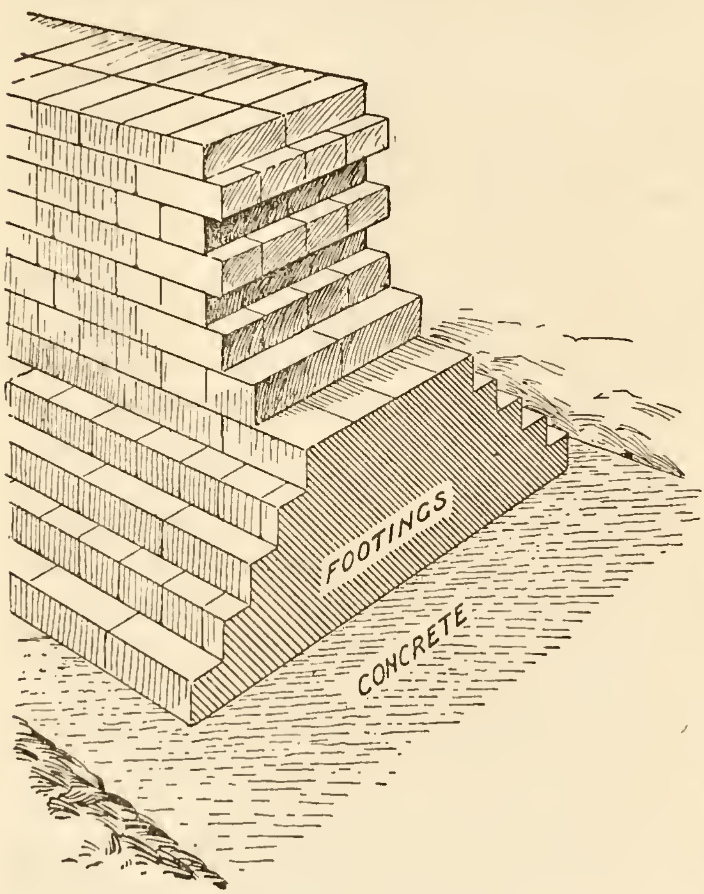

Fig. 116.—Footings.

It is important that the foundation of a wall should be laid at a sufficient depth. The ground must be excavated until a bed of earth is reached that is not liable to be affected by the weather. All soils, and even rocks, are broken up by continued exposure to the weather, and so afford an insufficient support for the walls. Moreover, some soils, especially clay soils, tend within a few

feet from the surface to expand and contract as the weather changes. If the foundations are not taken down to such a depth that these influences become practically inoperative, the building sooner or later will show signs of settlement. This is an important point to be borne in mind by anyone who is about to purchase a house.

Foundations of Walls.

The foundations are usually formed by resting the walls on "footings," and the "footings" on concrete (Fig. 116). The concrete here should not be less than 18 inches thick, and in heavy buildings this thickness should be much exceeded. The concrete should project on each side of the footings for at least 6 inches. The "footings" is the name given to the brick base upon which the wall

"Footings."

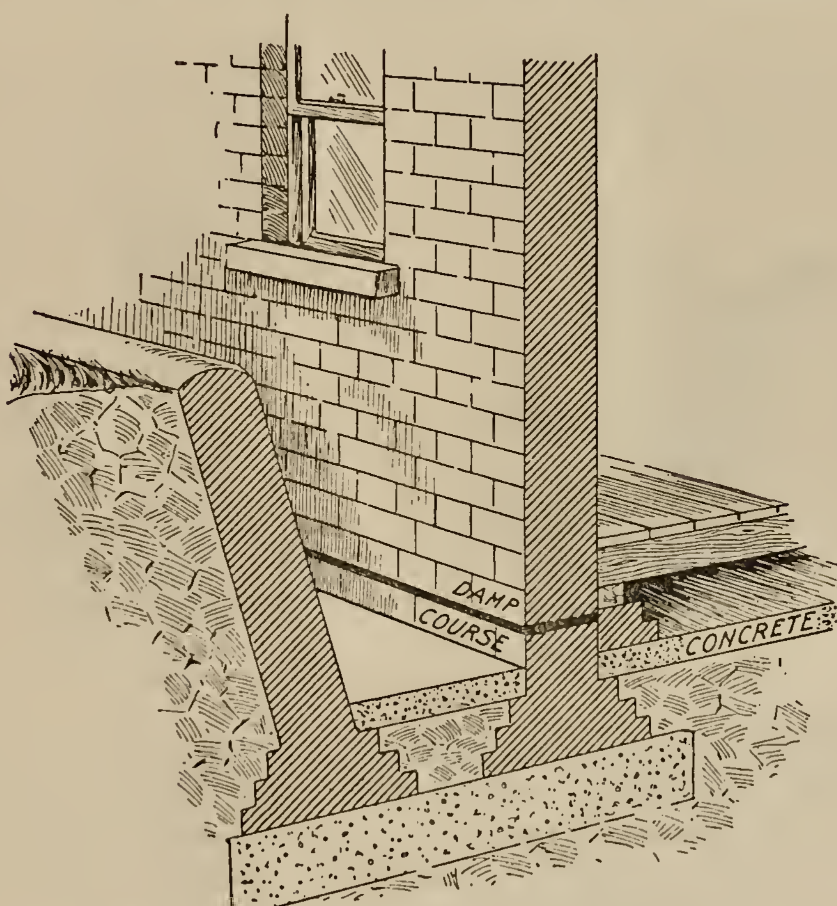

Fig. 117.—DAMP COURSE WITH EXCAVATED AREA.

rests. The height and width of the footings vary with the thickness of the wall immediately above them; in height the footings should

be equal to two-thirds of the thickness of the wall, and they should project on either side for a distance equal to half the thickness of the wall. In the case of an 18-inch wall the height of the footings should be 12 inches, equal to four courses of brickwork, while the width at the widest part will be 3 feet.

DAMP COURSES

There is a constant tendency for moisture from the ground to rise in the walls, and to prevent this it is necessary to insert above the footings a horizontal layer of waterproof material. This is the damp course, and it may consist of asphalte, sheet-lead, or slates laid in cement. Various kinds of bituminous felt are sometimes used to form damp courses,

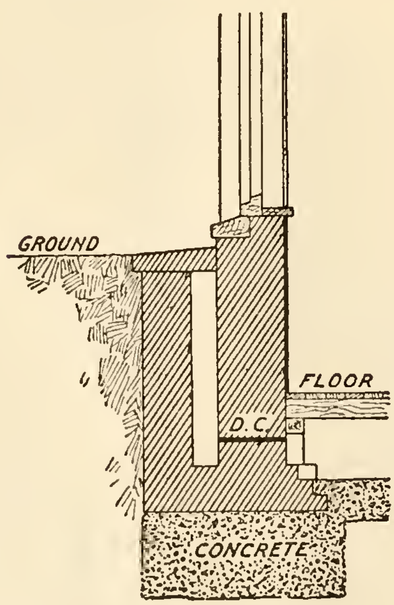

Fig. 117A.—Damp Course with "Dry Area."

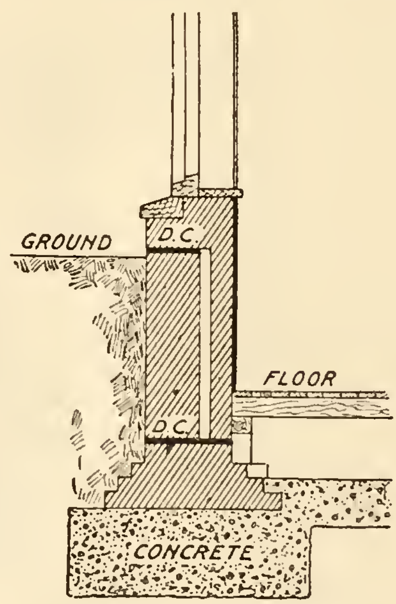

Fig. 117B.—Double Damp Course.

but they tend to disintegrate, and cannot be regarded as satisfactory. The damp course should extend along the entire width of the wall, and should be laid below the level of the lowest timbers and well above the surface of the adjoining ground. In basement or half-basement houses, two horizontal damp courses must usually be provided, one just above the footings, the other above the ground level, and some form of vertical damp course must be provided to protect the wall from damp between the two hori-

Double Damp Course.

zontal damp courses. There are various ways of doing this, the most effective being to excavate an open area all round the house (Fig. 117). The bottom of this area should be below the level of the floor, and the area should be properly paved and drained. An open area is, however, somewhat expensive, and in town houses is generally impracticable.

The same object may be attained by forming a "dry area" (Fig. 117A), which is a cavity of sufficient width to keep the moist earth from the outer surface of the wall. If an open area or a dry area be provided the upper of the two horizontal damp courses will be found unnecessary.

A third method is to form a cavity in that part of the wall that is below the surface of the ground (Fig. 117B). In this case two damp courses will be required, one just above the footings, the other in the outer part of the wall a few inches above the ground. These cavities should always be ventilated and drained, and this is sometimes a difficult matter to arrange. Moreover, they are liable to harbour vermin, and on the whole it will be found more expedient to fill in the cavities with asphalte.

WALLS

The materials of which the walls are made should obviously be durable, and it is important also that they should be bad conductors of sound and heat and impervious to air and moisture. A sound-proof wall is a great advantage, particularly in terrace houses, and also for all rooms where noise is normally generated, such as nurseries and rooms used for the practice of singing or musical instruments. Non-conductivity of heat is also an important matter. A house whose walls are made of good conducting material will lose artificial heat from the interior in winter, and will take up heat from the sun readily in summer. Such a house will be too cold in winter and too hot in summer. The conducting capacity of a wall depends partly upon its thickness, thick walls being bad conductors, and partly upon the materials of which the wall is composed.

Non-conductivity of Heat.

The following table, calculated by Douglas Galton, gives the number of units of heat transmitted per square foot per hour by materials 1 inch thick, with a difference of 1° F. between the two surfaces :—

Marble, grey, fine grained	28
Marble, white, coarse grained	22
Stone, ordinary freestone	13·68
Glass	6·6
Brickwork	4·83
Plaster	3·86
Fir planks	1·37
Brickdust	1·33
Chalk, powdered	0·87

It will be seen from this table that brickwork is a relatively non-conducting material.

There is some difference of opinion on the relative advantages of a wall that is impermeable to air. It is sometimes held that a permeable wall favours ventilation, and that the presence of air in the interstices of the material diminishes the conducting capacity of the wall. The latter object, however, can be secured by other means, and as to ventilation, the quantity of air passing through a wall is so slight that it is practically useless. Douglas Galton has found that with an external temperature of 40° F. and an internal temperature of 72° F. the number of cubic feet of air admitted per hour by a square yard of wall varies according to the material used, as follows :—

Impermeability to Air.

Sandstone	4·7
Quarried limestone	6·5
Brick	7·9
Limestone	10·1
Mud	14·4

It appears, then, that the advantages of a wall permeable to air are negligible ; but the disadvantages are substantial : the air will carry with it living organisms and a certain amount of dead organic matter, which will decompose in the wall. Moreover, a wall permeable to air will also be permeable to moisture, and everybody agrees that moisture should be kept out of the walls of a dwelling house.

In this country walls of dwelling houses are built of brick, stone, or concrete blocks ; the latter, however, are seldom used for the outer walls. Houses are commonly built of stone in the districts where there are stone quarries, but, speaking generally, brick is far the most popular material for walls. Bricks vary considerably in quality and consequently

in price, and one of the favourite methods employed by the jerry builder to reduce the cost of the building is to substitute bad bricks for good.

BRICKS

Bricks are generally made of a standard size of 9 inches long, 4½ inches wide, and 3 inches thick. Good bricks should be uniform in colour and regular in shape. They should bear weight well, and not crack or scale if exposed to frost, and they should not absorb more than one-fifth of their bulk of water. A good stock brick weighs about 6½ pounds, and the harder and heavier bricks are usually the better. The quality of bricks may readily be tested by taking one in each hand and knocking them together. Good bricks so tested should give out a clear metallic sound.

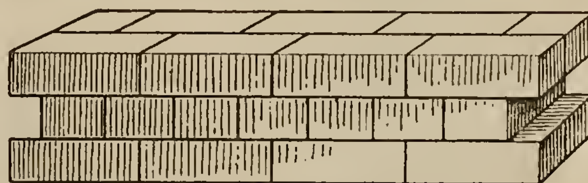

Fig. 118.—English Bond.

Bricks are laid in beds or "courses," and are interlaced or "bonded" together. There are two methods of bonding in common use in this country, the English bond and the Flemish bond. In the English bond a course of bricks laid end to end ("stretchers") alternates with a course laid side by side ("headers"). In the Flemish bond, which was introduced into England during the reign of William and Mary, each course consists of "stretchers" and "headers" laid alternately. It is generally held that the English bond gives a stronger tie in the direction both of the length and of the width.

Bonds.

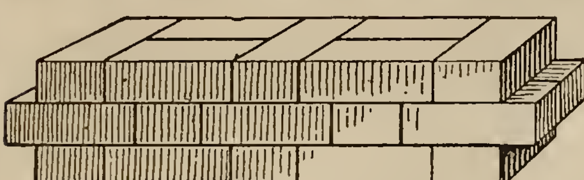

Fig. 119.—Flemish Bond.

It is sometimes advisable to strengthen the walls by a bond consisting of strips of hoop iron laid between the courses of bricks for about four courses of brick in height, but this should not be necessary in a dwelling house laid on good foundations. If iron is used for this purpose it should be tarred to prevent rust.

MORTAR

Good mortar is made up of 1 part of slaked lime to 3 or 2½ parts of clean sharp sand. The sand should be fine, and free

from small stones, clay, earth, and other impurities. These impurities may be removed by washing the sand, which should always be done. The lime should be slaked with fresh water. If salt water is used, or if impurities are present, the adhesive qualities of the mortar will be impaired.

Mortar affords a medium for the exercise of some of the characteristic "economies" of the jerry builder. The use of inferior mortar is very common—road sweepings are not infrequently used; and another favourite dodge is to lay the mortar in thick beds and so economise in the use of bricks. The proper use of mortar is to make the bricks adhere together, and a layer a quarter of an inch thick is ample for this purpose, and therefore should not be exceeded. The upper edge of the layer of mortar should be slightly indented, and the lower edge made flush with the surface of the bricks below in order to throw off the rain.

Before leaving the subject of the walls it should be stated that where a house occupies an exposed situation it may be necessary to take special precautions to keep out the driving rain. There are various ways of doing this. The outside of the walls may be covered with slates or glazed tiles, or Portland cement may be used as an outer covering to the brickwork. Sometimes the walls are covered with "roughcast," which consists of small pieces of flint, sprinkled shingle, etc., set in a special kind of mortar. Another plan is to construct the outer wall with a cavity, or to make the wall of two layers of brickwork with a layer of asphalte between. These points should be borne in mind by intending purchasers of houses in exposed positions at the seaside or elsewhere.

ROOFS

The outer shell of a house consists of foundations, walls, and roof; the two former have already been described, and it now remains to deal with the roof. A roof consists of two main parts, the framework and the covering material, and the chief points to be noted in a roof are (1) that the framework is strong enough to bear the weight of the covering, together with the maximum amount of snow that is likely to rest upon it, and (2) that the covering is securely fastened to the framework, is impervious to rain and snow, is non-conducting, and is so constructed that rain and melted snow pass off it readily.

There are many kinds of roof, but the following are those most commonly used in dwelling houses :—

1. The "lean-to," with only one slope, leaning against a vertical wall (Fig. 120).

2. The "**M**" or "ridge and furrow," formed by two triangular roofs side by side (Fig. 121).

3. The "**V**" roof, formed by two lean-to roofs meeting in a gutter, the slopes resting against the party wall (Fig. 122).

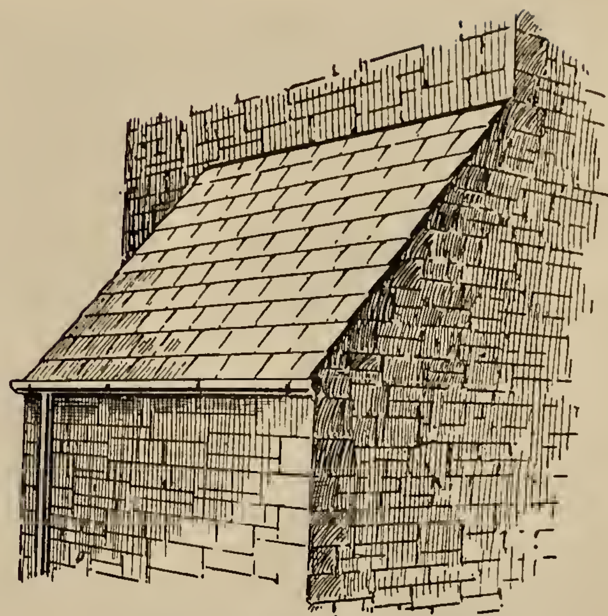

Fig. 120.—"Lean-to" Roof.

The simplest form of wooden roof is the triangular or "couple" roof, which consists of parallel rafters fixed at the required inclination to a "ridge board" placed at the apex of the triangle. The other ends of the rafters are fastened to a length of wood, or "side piece," embedded in the top of the wall. A roof constructed in this way has a tendency to thrust out the walls on which it rests, and to counteract this tendency it is usual to tie the side-pieces together by a light beam, called a "collar." In roofs with a greater span than 15 feet additional precautions should be adopted.

The roof should be covered with flat boards laid at right angles to the rafters, and it is advisable to interpose a layer of felt between the boards and the slates or other outer covering material. Felt is a non-conductor of sound and heat, and a layer of felt in the roof will tend to make a house quiet and of an equable temperature.

Roof Covering.

In this country the outer covering of a roof usually consists of slates or tiles, but in some districts thin slabs of stone are used. Zinc, lead, galvanised iron, tarred felt, and thatch are also employed as roof covers. The material used for the outer covering has an important bearing on the *slope* of the roof. The more pervious the covering the greater the slope will have to be, so that any wet falling upon the roof may be readily carried away. A thatched roof should have an inclination of not less

than 45° ; stone slabs and tiles—which, being more or less porous, absorb a certain amount of moisture—require an inclination of about 30°. The inclination of ordinary slating should be about 26°; of large slab slates, about 22°; while metal coverings, which are impervious, and can be laid in large pieces, whose few joints can be specially protected, require merely a very slight inclination.

Slates.

Slate is by far the most commonly used material for roof covering. For some reasons this is to be regretted. A slate roof is not a beautiful object, and a large mass of slate roofs is anything but pleasant to the eye. Moreover, the demand for slate has led to the destruction of some exquisite scenery by the formation of huge disfiguring quarries in the most beautiful districts of Wales. But slates are much too serviceable as building material for considerations such as these to interfere with their use.

Fig. 121.—"Ridge and Furrow" Roof.

A good roofing slate should be hard, fine grained, and almost non-absorbent. If immersed in water it should not show any sign of moisture on the part above the water. It should not emit a "clayey" smell when moistened, and it should give a clear, ringing sound when struck. Slates are cut in various sizes, which are known as "Empresses" (26 by 15 inches), "Princesses" (24 by 14 inches), "Duchesses" (24 by 12 inches), "Marchionesses" (22 by 11 or 12 inches), "Countesses" (20 by 10 inches), "Ladies" (from 16 by 10 inches to 14 by 7 inches), and "Smalls" (12 by 6 inches). The "Countess" size is most commonly used, and a good slate of this size should be about $\frac{1}{6}$ inch thick.

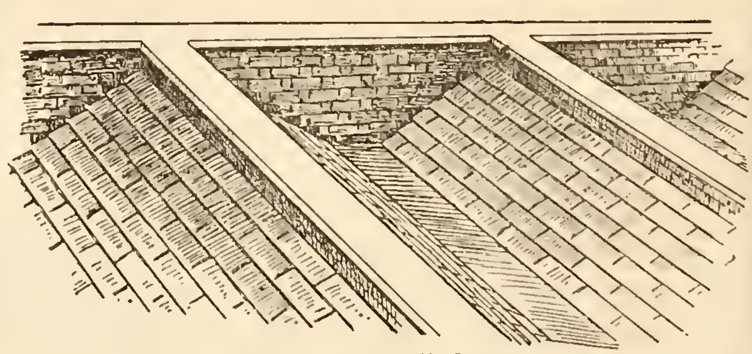

Fig. 122.—"V" Roof.

It is very important that the slates be properly laid. Each row should overlap the row below by 3 inches. If, from motives of economy or for other reasons, the "lap" be less than 3 inches, rain or snow may be driven under the slating. The slates should be fastened to the boards with nails of copper, brass, or zinc; iron nails should never be used for this purpose. Care should be taken to prevent wet coming through the roof at the angles formed by the slating with the brickwork round chimneys or at the party wall, etc. This is usually effected by means of a lead "flashing," which is a strip of lead whose upper edge is inserted in the joints of the brickwork. The lead is then carried down, bent at a right angle over the joint, and carried over the slates for a sufficient distance to prevent the wet from penetrating. A cement flashing is sometimes used, but cement is not suited for this purpose, as it cracks away from the brickwork.

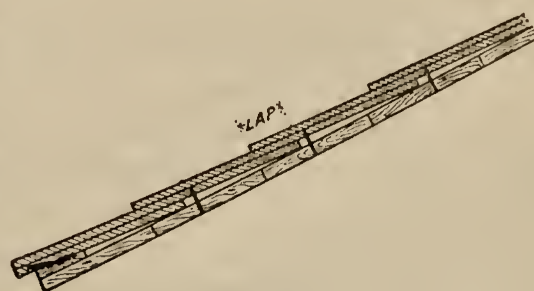

Fig. 123.—"Lap" of Roof.

A roof must, of course, be provided with gutters and rainwater pipes, but these will be described in the section on Drainage. It is desirable to provide means of access to the roof in order to obviate the necessity for using a ladder, with possible damage to the eaves, when the roof needs repair. Access is best provided by a dormer, for a trapdoor in the roof tends to let in the rain.

We have now mentioned the chief points of construction of the outer shell of a house, and we may therefore begin to consider the interior. Let us first take the

FLOORS

The construction of a basement floor has already been indicated in describing the foundations. The concrete used for covering the site may form the basement if the surface is properly made with Portland cement, flags, tiles, or asphalte. The upper floors are made of boards laid on joists, and this construction is generally adopted for the ground floor of a non-basement house. But in the latter case it is most important that the space beneath the ground floor should be well ventilated, otherwise the timber will be attacked by a fungus known as "dry rot." Ventilation is secured by laying the joists at a sufficient height to leave

a clear space of at least 3 inches between the surface of the concrete covering the site and the under surface of the joists, and providing an adequate number of air bricks, or other grated openings to the open air, to ventilate this space. To secure free ventilation beneath the floor it is necessary that these openings should be provided on all the free sides of the house.

Sometimes the lowest floor is formed of wood blocks laid on concrete. The site is first covered with a thick layer of concrete, on which the blocks are laid. In this construction the blocks should be not less than 3 inches thick, and the concrete should be well covered with asphalte, for the concrete will not suffice to keep out the damp. It is better not to adopt this method, but to provide a freely ventilated space under the floor timber.

Joists.

The joists, which are the small beams carrying the floor boarding, vary in depth and thickness with the distance between the walls on which they rest. This distance is called the "bearing." The following table indicates the variations in depth and thickness usually observed by good builders :—

Distance between walls (in feet)	*Dimensions of Joists (in inches)* Depth	Thickness
7 to 10	6	2
10 to 12	6	2½
12 to 14½	7	2½

When the bearing exceeds 14½ feet the joists should be supported between the walls by "girders" of wood or iron, which should be placed not more than 10 feet apart. The distance between the joists should not exceed 12 inches.

Floorboards.

Floorboards should be planed on both sides and on both edges, and laid close together. It is important to prevent dust or particles of organic matter from falling between the boards, and as even in seasoned timber there is some shrinkage after the floor is laid, the boards should be tongued and grooved, not only along the sides, but also at both ends. But the best floor surface is oak parquetry, which consists of pieces of oak ½ inch thick laid on the boards. Parquetry well laid and well polished forms an admirable floor. Floorboards, like all timber used in dwelling houses, should be well seasoned, and of good quality. In timber, as in other building materials, true

economy is to be found in using good material. Cheap material will be found the dearest in the long run.

INTERNAL SURFACE OF THE WALLS

Internally the walls are coated with plaster, which renders the wall more impervious, more non-conducting, and more easy to clean. A good plastered surface is hard, dense, smooth, and non-porous. A porous plaster soon becomes foul with the organic impurities it has absorbed. Plaster is usually laid in three coats. The first is composed of equal parts of sand and lime, the second of "fine stuff," which consists of lime slaked with a little water and mixed to the consistency of cream. The third, or "setting coat," is a thin layer of fine stuff or of "gauged stuff," which is a mixture of lime, water, and plaster of Paris. Sometimes the wall is finished with Keene's cement, a material that takes a high polish.

Wall Paper.

The walls of a new house should not be papered until they are thoroughly dry. It will be better to colour them in distemper for a year or even longer. There is, indeed, much to be said for continuing the distemper permanently, and so avoiding the use of wall paper. A well plastered wall covered with distemper forms a surface that is much more easily cleaned than a papered wall.

Most people, however, prefer paper to any other internal wall covering, and it will be well to refer to a few points that should be borne in mind in this connection. The first point is that no new paper should ever be hung unless all the old paper that is already there has been cleared away. This is an obvious precaution, but it is frequently neglected. Paper is a vegetable product, so is the paste which is used in paper-hanging. Both tend to decompose, and a number of layers of paper can become highly offensive. At the old Knightsbridge Barracks there was at one time a horrible stench which gave rise to several cases of illness and a great deal of discomfort. It was found to be due to the putrefaction of the under layers of paper on certain walls in the officers' quarters. These walls were covered with numerous layers of paper, those nearest the wall being in a disgusting state of decomposition. The removal of the old paper will possibly bring away some of the plaster. Any defects of this kind must be made good, and the wall thoroughly washed before the new paper is hung.

Another source of nuisance is the use of putrid paste in paper hanging.

Paste for this purpose should be made of the best white wheat flour and clean water, and should be used fresh. If there is any bad smell in a newly papered room, the paste should be suspected. A wall paper should not absorb dust or moisture, and therefore rough papers—especially flock paper—should be avoided. Flock papers have a remarkable capacity for holding dust, and for absorbing vapour and impurities from the atmosphere of the room. A good wall paper should be smooth and glossy. Varnished papers have many hygienic advantages; they are non-absorbent and are easily cleansed.

A wall paper should not be purchased unless it is guaranteed free from arsenic or other poisonous substance. Poisonous wall papers are not common at the present time, but formerly they were much in use, and constituted a grave public danger. Some twenty years ago the Medical Society of London appointed a committee to investigate the matter. The committee issued a circular of inquiry to the medical profession, and many cases of arsenical poisoning were brought to light which were traced to living in rooms papered with arsenical wall paper.

Poisonous Wall Papers.

The arsenic occurs in the colouring pigments, and various preparations may be used. Green arsenic-containing pigments were formerly much used, the most common being Scheele's green (arsenite of copper) and emerald green (aceto-arsenite of copper); but many other colours have been found to contain arsenic in considerable quantity. King's yellow, for instance, is composed of sulphide of arsenic. In some wall papers arsenic has been found in the proportion of 60 grains per square foot of paper. There is a case on record of three horses having died of arsenical poisoning after eating some green wall-paper that had been stripped off their owner's house during a spring cleaning.

Arsenic is disseminated as solid particles in dust, or as the vapour of arseniuretted hydrogen. Fine particles of arsenic may be rubbed off the wall and diffused in the air of the room. This is particularly likely where flock papers, coloured with arsenic, are used. Arseniuretted hydrogen—a very deadly gas—is formed by decomposing size or paste acting chemically on the arsenic in the paper.

The symptoms of chronic arsenical poisoning, which is the form of poisoning due to the continued inhalation of arsenic from wall papers, are very insidious. First the eyes become red and watery; then there is a slight cough accompanied by a feeling of nausea and slight diarrhœa.

The patient gradually grows weaker, and in more severe cases there may be pains in the abdomen, headache, dryness of the mouth and throat, and gradual paralysis of the extremities. As a rule, the symptoms are not very severe, and the patient may be ill for a considerable time before the nature of the malady is ascertained. It is not improbable that arsenic is more dangerously prevalent than is commonly supposed. The reader will doubtless remember that some years ago there was a terrible outbreak of arsenical poisoning in Lancashire, which was due to the consumption of beer that had been brewed with glucose containing arsenic. In this outbreak several thousand persons were attacked, and there were many deaths; and before the outbreak no one ever thought that beer could contain arsenic. It may well be that many obscure cases of illness are due to the absorption, in some unknown way, of small quantities of arsenic. New methods of food preparation and new methods of building construction are constantly being evolved, and there is need for constant watchfulness lest we thereby introduce new and subtle influences injurious to the health of the community.

It is a fairly simple matter to test wall paper for the presence of arsenic. Take a piece of the paper about 4 inches square, cut it up into small pieces and place them in a test tube; add water until the tube is nearly one-third full, and then add about a teaspoonful of pure hydrochloric acid. Now add a small piece of sheet copper, and heat the test tube in the flame of a spirit lamp. If arsenic is present the copper will be coated black, and if the copper is removed, dried between filter paper, placed in a small test tube, and heated, fine white crystals of arsenic will be deposited on the inner side of the test tube about half way up. It is important that the hydrochloric acid should be guaranteed free from arsenic, and this should be verified by heating a little of the acid with a piece of sheet copper in a test tube before proceeding to test the paper.

Arsenic is not the only poison that may be found in wall papers. Colours containing preparations of mercury, copper, cobalt, and lead are sometimes employed, and it is a mistake to think these poisonous colours must necessarily be bright; the less obtrusive tints may be equally poisonous. But manufacturers of wall paper are more careful not to use poisonous pigments than was the case some years ago, and poisonous wall papers are not often met with nowadays.

CEILINGS

The ceiling laths are usually nailed to the under surface of the floor joists, but if a lath and plaster ceiling be provided it is better to have two sets of joists, the upper set supporting the floor, the lower set, the "ceiling joists," being used solely for the purpose of supporting the ceiling. This plan has the advantage that the ceiling is less likely to be jarred by movements on the floor above, and sound is more effectually prevented from passing from one floor to another. The surface of the ceiling is formed of plaster, which should be either whitewashed or painted. It is a mistake to paper a ceiling.

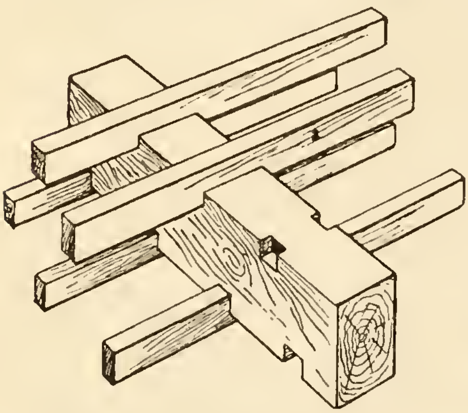

Fig. 124.—Double-floor Joists.

The disadvantage of the ordinary lath and plaster ceiling, whether constructed with separate ceiling joists or not, is that it leaves long, unventilated cavities between the joists, which become eligible breeding places for vermin, and receptacles for various kinds of dust and rubbish. And even if these spaces are ventilated, by perforated bricks or other means, the disadvantages are far from being removed. From a health point of view it is much better to do away with plastered ceilings altogether, and to stain or varnish the joists and floor boards and leave them exposed.

CHAPTER CII

HEALTHY HOMES (*concluded*): SANITARY ARRANGEMENTS

Warming: Radiation and Convection—Ventilation—Lighting, Natural and Artificial—Water Supply—Removal of Refuse—Drainage—Rain-water Pipes—Water-closets—Keeping the House Clean.

Warming

In this country it is necessary that dwelling houses shall be provided with means of artificial heating, in order that a proper temperature may be maintained. What is a proper temperature varies to some extent with the individual peculiarities of the persons living in the house. Some persons appear to require a warmer room than others, and these differences occasionally give rise to a little domestic friction. Usually, however, a temperature of from 60° to 65° F. will be considered comfortable.

Heat may be transmitted in three ways—by radiation, convection, and conduction. Heat is *radiated* when it passes from one body to another without heating the intervening medium; it is *conveyed* when heated particles travel from one place to another; and it is *conducted* when it passes directly by immediate contact from a hotter to a colder body, or from the hotter to the colder parts of the same body. Conduction plays a very minor part in the heating of dwelling houses, and may be disregarded.

RADIATION

The Briton prefers to warm his house by the radiant heat of an open fireplace. The fireplace has many disadvantages, but it is generally held that its cheerful appearance more than compensates for them. The fireside figures largely in our literature, and it is safe to say that an Englishman's home would not, to most Englishmen, seem like home without its open fireplace.

The fireplace, moreover, has important hygienic advantages. It is a powerful ventilator, and it gives out heat without adding impurities to the air. But it is wasteful, for it has been calculated that while one-quarter of the heat generated is expended in warming the walls, floors, etc., in the room and one-eighth in warming the air of the room, no less than five-eighths escapes up the chimney. Moreover, the heat is very unequally distributed throughout the room. The intensity of radiant heat varies inversely as the square of the distance of the heated object from the source of the heat, and therefore an object placed, say, at 4 feet from the fire will receive one-sixteenth of the heat received by an object at a distance of 1 foot. Of late years many reforms have been effected in the construction of fireplaces, the chief reformer being Mr. Pridgin Teale, the eminent Leeds surgeon. The main improvements recommended by Mr. Teale are as follow :—

1. The base, sides, and back of the fireplace should be formed of fireclay.

2. The sides should be splayed out so that the width of the grate at the back is about one-third of the width at the front.

3. The back of the grate, instead of rising vertically upwards, should slope forwards. In this way the throat of the chimney will be narrowed, and the angle formed by the fireplace and the chimney flue should be 135°. This construction of the sides and back will intercept heat that would, in the ordinary grate, go up the chimney, and the heat so intercepted will be radiated into the room.

4. The floor of the grate should not be formed of fire-bars, but of a solid slab of fireclay.

5. The fireplace should be brought well forward into the room, and the grate placed low down near the floor.

In the "well grate" there are no fire-bars in front of the grate, and the air is admitted beneath a raised hearth, the surface of which is formed of glazed tiles, which reflect the heat from the fire into the room.

Fireplaces constructed on the lines laid down above are cleaner, healthier, loss costly, and more effective than the iron grates in ordinary use.

Gas fires are becoming increasingly popular, and there is much to be said in their favour. They have the great advantage of being clean ; they entail no carrying about of dusty coal, and they give rise to no soot in the chimney. With a gas fire a room can quickly be raised to

the required temperature, and the amount of heat given out can be regulated at pleasure. Gas fires save an enormous amount of rather dirty labour, and to the worried housewife, confronted with the growing complexities of the servant problem, this is a consideration of first rate importance. And we must not forget that the increasing use of gas fires for warming and cooking promises to do much to abate the smoke nuisance. Experienced Londoners say that London fog is not now so black as it was before gas fires came into use. The blackness of fog is due to the unconsumed carbon or soot thrown up into the atmosphere from the chimneys. Gas fires give rise to no soot, and as the sulphur compounds produced by the burning of gas are less than those produced by burning coal, the use of gas fires tends to free the atmosphere from sulphur as well as soot. It is not generally realised what we lose by the heavy pall of smoke that overhangs most of our large towns. London is better in this respect than many towns, but even now it is estimated that every day the chimneys of London throw 300 tons of soot into the air that Londoners have to breathe. Dr. Shaw, of the Meteorological Office, has estimated that "in summer London loses one-sixth of its sunshine and presumably also about the same fraction of its daylight, on account of its smoke; while in winter its loss amounts to one-half for a similar reason." Sir W. T. Thiselton-Dyer found that after a week of fog in London in 1891 there was on the greenhouses in Kew Gardens a deposit of tarry matter equivalent to six tons to the square mile.

Gas Fires.

This deprivation of light and sunshine has serious effects on health. Light is an important part of a healthy environment. The depressing effect of dark days and the stimulating or energising influence of bright sunshine are matters of common experience. More especially is light of importance to young children, in that momentous period when the marvellous processes of growth are taking place, and it is very probable that the high infantile mortality of our manufacturing towns must to some extent be attributed to the smoke that overhangs them.

But if gas stoves or gas fires are used two precautions should be observed. In the first place, a flue should always be provided to carry off the products of combustion. This is a rule to which there is no exception. An unventilated gas fire should always be regarded as a nuisance.

The other precaution, like the first, should always be taken where gas is "laid on" to a house. It is that no leakage of gas should occur. This

precaution is more imperative than was formerly the case on account of the increasing use of *water gas*. Water gas is made by blowing steam through incandescent coke raised to a high temperature. The steam is split up into hydrogen and oxygen ; the hydrogen remains free and the oxygen unites with some of the carbon to form carbon monoxide (CO), other products also being formed. Water gas is much less costly to produce than coal gas, it is superior in heating power, and in combustion it gives rise to no sulphur products. These are important advantages, but there is the great disadvantage that it contains from 25 to 35 per cent. of carbon monoxide, one of the most deadly poisons known. An escape of water gas is a very grave matter.

One way of guarding against the effects of gas leakage is to insist on free ventilation. People who sleep with the bedroom windows open escape many dangers, one being that of carbon monoxide poisoning. It will be remembered that M. Zola, who died from this cause, was attempting, when he was finally overcome, to reach and open a window which should never have been closed.

CONVECTION

So far we have dealt with warming by *radiation—i.e.* the transmission of heat in the form of radiant energy which becomes converted into heat on reaching the objects to be heated ; we may now proceed to indicate the various methods of heating by *convection*. By these methods the air in contact with the source of heat is warmed and expands, as in expanding it becomes lighter than the surrounding air, it rises, and its place is taken by cooler air, which in turn becomes heated, expands, rises, and gives place to air from the colder parts of the room. In this way currents of warm air are set up, and these, circulating about the room, give out heat and tend to keep the air in all parts of the room at an equal temperature. There are various ways of heating by convection : stoves, hot-water pipes, or steam pipes may be used ; or the air conveying the heat may be warmed in a central heating chamber and distributed to the various parts of the house by means of pipes.

On the Continent the warming of dwelling houses is almost universally effected by stoves, but in this country the stove has never been able to compete with the open fire for popular favour. Nevertheless, stoves have several important advantages over the open fire. In the first place, they bring about a more uniform warming of the room. The open

fire warms chiefly by radiation, and radiant heat, as we have seen, rapidly loses in intensity as it travels from the source of heat. A stove warms by setting up currents of warm air which are themselves sources of heat, and which rapidly convey heat all over the room. Secondly, there is an economy in the consumption of fuel. Combustion is slower and more complete in stoves, and therefore a given quantity of fuel produces a greater amount of heat. Thirdly, there is economy in the use of the heat produced by the fuel. In an open fire the heating surface is small, and most of the heat produced, as we have seen, goes up the chimney ; in a stove the heating surface is comparatively large, and a much greater amount of the heat produced is expended in doing its proper work—warming the room.

Stoves.

But in spite of these advantages, stoves have serious drawbacks. They lack the ventilating power which is the great recommendation of the open fire. Fires are less economical than stoves, but it is well worth while to incur the extra expense they entail for the sake of the ventilation they provide. Moreover, stoves make the air of a room too dry—although this objection may be met by placing vessels of water in the room—and when the walls of the stove become overheated, as they often do, the organic matter in the air in contact with the heated surface becomes charred, and produces an unpleasant smell.

One of the most serious disadvantages of stoves is the danger of carbon monoxide poisoning, which has already been referred to in connection with gas leakage. This danger is especially to be feared where a stove of cast iron is in use. It is not quite clear how stoves pollute the air with carbon monoxide, but it has been suggested that the hot metal, acting on the organic matter in the air immediately in contact with it, produces this dangerous gas by a process of incomplete combustion. It is more generally held, however, that the gas is produced in the fire, and that it passes out into the air either through defective jointing or through minute fissures in the metal. But as to the fact of the production of carbon monoxide there is unfortunately no doubt ; and if a stove is used it should not be constructed of cast iron. The danger of cast iron may to some extent be lessened by lining the iron inside with fireclay. This is a non-conducting substance, and therefore prevents the iron from being overheated. It is better, however, to dispense with cast iron altogether and to employ one of the stoves made entirely of fireclay and china that are now upon the market.

Heating by hot water is chiefly employed for public buildings, schools, etc., but it is being increasingly used in dwelling houses. Hot water is an excellent warming agent, because, possessing a high specific heat, a small amount of water in cooling gives out sufficient heat to raise the temperature of a very much larger volume of air. There are two hot water systems—(1) the low pressure and (2) the high pressure.

Hot Water.

In the low pressure system the water is heated in a boiler, from the upper part of which the hot water ascends through a pipe, which as it goes along gives off branches to the parts of the house to be supplied. As the hot water leaves the boiler through the pipe at the top of the boiler, cold water enters the boiler through a pipe at the bottom. The hot water, travelling through the ascending pipes, which may be aggregated at various points to form radiators, gives off its heat to the surrounding air, and ultimately passes down the descending pipes to reach the bottom of the boiler. The water is thus kept in circulation, because the hotter water, expanding, becomes lighter bulk for bulk, and therefore ascends, its place in the boiler being taken by the colder water in the descending pipe.

Low Pressure System.

In this system the pipes are of cast iron, and, as it is desirable to provide a large heating surface, the diameter of the pipes should be 3, or preferably 4 inches. The temperature of the outer surface of the pipes should be from 120° to 140° F., and for every 1,000 cubic feet of air space 12 feet of 4-inch pipe should be allowed. This will heat a room to 65° F. A safety pipe must be provided at the highest point of the system for the escape of steam and air. In the low pressure system the temperature does not exceed about 200° F.

In the high pressure system there is no boiler, and the pipes form an endless tube, one coil of which, of about one-sixth of the total length, passes through the furnace. The pipes are of wrought iron and have thick walls, the internal diameter being from $\frac{1}{2}$ to 1 inch. There is no escape pipe, but in order to provide for the expansion of the water, and so prevent bursting, a portion of the pipe at the upper part of the system is somewhat enlarged. In this system the water is heated to 300° or 350° F., and it is estimated that a length of 8 or 9 feet of high pressure piping is equal in heating capacity to 12 feet of low pressure piping. The high pressure system,

High Pressure System.

however, is not free from danger, and the low pressure system is preferable, at all events for dwelling houses.

Electric Heaters.

Electric heaters consist of a set of electric heat lamps arranged in front of a bright reflecting surface. In the heat lamps the electrical energy is passed through thick wires, considerably thicker than the wire of ordinary incandescent lamps, and the resistance thus encountered converts the energy partly into heat and partly into light. Electric heaters communicate heat partly by radiation and partly by convection. From a health point of view electrical heating is probably the best. It is certainly the cleanest. It requires no dirty fuel; it gives rise to no dust, ashes, cinders, or smoke; it does not foul the air in any way, and it obviates the use of gas pipes with their probabilities of leakage. Electrical heating, like hot-water heating, has, however, one important drawback—it does not, as a fire does, compel the provision of ventilating openings. A fire without a chimney would be an intolerable nuisance; but it is possible—though, of course, very unhealthy—to have hot-water pipes or electric radiators without any openings at all. It is most important, therefore, that special attention should be paid to ventilation if either of these methods of heating is adopted.

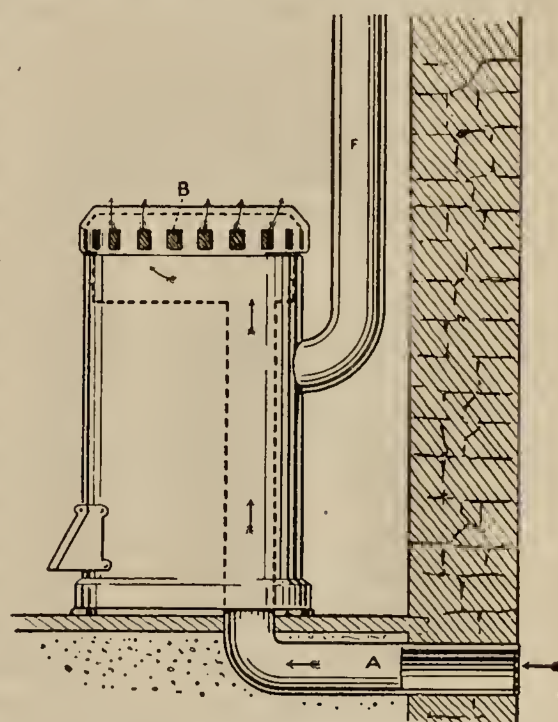

Fig. 125.—Ventilating Stove.

Ventilating Stoves.

It is characteristic of the ordinary English middle-class dwelling house that there is usually no provision made for the warming of the lobbies, staircase, and passages; and American visitors to this country frequently express surprise that we should tolerate what seems to them to entail a serious lack of domestic comfort. This a real objection, and it can readily be removed by providing a ventilating stove in the hall, which will not only warm the staircase and passages, but will also convert the hall into a reservoir

of pure warm air, which may be used to ventilate the rooms. Fig. 125 shows how this may be done. Fresh air from the outside is admitted through the lower pipe A, which is continued through the stove and ends at the opening B. The pipe F is the flue from the stove. When the stove is lighted fresh air is drawn in through A, warmed in passing through the pipe in the stove, and, issuing from the stove at B, is distributed all over the house. If the hall and passage are warmed in this way, it is possible, as Dr. Vivian Poore has pointed out, to ventilate the rooms from the passages by placing ventilators in the walls between the rooms and passages. The simplest way of doing this is to convert one of the top panels of a door into a louvre ventilator. The cost of converting a door panel into a ventilator is trifling, and the gain in ventilating capacity is enormous.

In describing the arrangements for warming a house we have been led to the subject of

VENTILATION

This we may now proceed to discuss in some detail.

Fresh air is a prime necessity of a healthy life, and one of the most important health problems that confront the dwellers in temperate climates is how to keep their habitations warm and yet fully supplied with fresh air. Stuffy, ill-ventilated rooms give rise to many diseases, the most important of which is consumption ; but it is only within a comparatively recent period that the subject of ventilation has begun to receive the attention its importance demands. Sir Douglas Galton states that " the architect is at last beginning to consider that a knowledge of the principles of ventilation and of the other details of sanitary construction is as necessary to the efficient discharge of his responsibility to his clients as a knowledge of building materials. But there are still thousands of private houses, and especially business buildings, offices, etc., having fair and inviting exteriors, and comfortably, even luxuriously, furnished, which are so deficient in a proper quantity of air and light as to render them breeding nests of consumption, rheumatism, and other forms of disease."

The effect of bad ventilation on consumption was strikingly illustrated by the mortality among our soldiers before the Crimean War, and the influence of the late Miss Florence Nightingale led to an overhauling of our military hospitals and barracks. In the years 1837–46 the death-

rate from consumption among the Foot Guards, whose barracks were specially overcrowded and stuffy, reached the enormous figure of 11·9 per 1,000 of the strength per annum. In 1858 the Royal Commission on the Organisation of Military Hospitals made their celebrated report, in which they described the shortcomings of our barracks and military hospitals in matters of ventilation. This report brought about a great improvement. The standard of cubic space per soldier was raised and better ventilation was inaugurated, and as a result the death-rate from consumption among the Foot Guards fell in 1864–70 to 2·3 per 1,000. At the present time the mortality from consumption in the Army is below that of the male civil population at the same ages, but fifty years ago it was very much above it.

Open Air and Consumption.

The publicity that has of late years been given to the open-air treatment of consumption has called popular attention to the value of fresh air. If it is good for the cure of consumption to live in the open air and to sleep with the bedroom windows wide open, it must also be good for the prevention of consumption to do these things. The late Sir William Broadbent used to say that the death rate from consumption would fall 50 per cent. if all the population could be induced to sleep with the bedroom windows open. The prevalent superstition that night air is injurious, and must not be admitted into the bedroom, is a fruitful source of consumption, and he who should effectually slay this superstition would confer a great benefit on the human race. Night air outside the house is not injurious; the night air that is injurious is that which is inside the bedroom whose windows are closed.

Origin of the Open-air Treatment.

It is often said that the open-air treatment of consumption originated in Germany, but this is a mistake. The father of the fresh-air treatment was Dr. George Bodington, of Sutton Coldfield, who published his views on the subject in his "Essay on the Treatment and Care of Pulmonary Consumption on Principles Natural, Rational, and Successful," in 1840. The following extract indicates Bodington's teaching about fresh air and consumption :—

"The only gas fit for the lungs is the pure atmosphere freely administered without fear : its privation is the most constant and frequent cause of the progress of the disease. To live in and breathe freely the open air, without

being deterred by the wind or the weather, is one important and essential remedy in averting its progress, one about which there appears to have generally prevailed a groundless alarm lest the consumption patient should take cold. Farmers, shepherds, ploughmen, etc., are rarely liable to consumption, living constantly in the open air, whilst the inhabitants of the towns and persons living much in close rooms within doors are its victims. The habits of these latter ought, in the treatment of the disease, to be made to resemble as much as possible those of the former class, as respects air and exercise, in order to effect a cure. How little does the plan of shutting up patients in close rooms accord with this simple and obvious principle!"

In this country Bodington's views met with nothing but opposition and ridicule; his sanatorium could find no patients, and was turned into a lunatic asylum. Twenty-six years after the publication of his essay he wrote to his son: "I often think that when I am dead and buried, perhaps the profession will be more disposed to do me some justice than whilst I lived." Bodington died in 1882, in his eighty-third year, without the slightest appreciation from his countrymen of the value of his work. But in Germany his ideas were bearing fruit. Dr. Brehmer was profoundly influenced by Bodington's writings, and in 1859 he established the famous sanatorium at Göbersdorf, in Silesia. Since then the open-air treatment of consumption has made great strides, and Bodington's posthumous fame has been well established.

Amount of Fresh Air Required.

Every human being is continually polluting the surrounding air with respiratory impurities, the most important of these being carbonic acid (CO_2) and a certain amount of animal matter, the nature of which is not precisely known. It is thought that the injurious effects of foul air are due not so much to the carbonic acid as to the animal matter, but as the amount of this keeps a constant ratio to the amount of carbonic acid, the latter is taken as a convenient index to the amount of the other impurities present. It is generally held that a polluted atmosphere becomes injurious when a person, entering the room from the outside air, is able to detect by the sense of smell that the air of the room is not so fresh as that outside. This point is reached when the air contains more than ·06 per cent. of carbonic acid. The atmosphere normally contains ·04 per cent. of this gas, so that the amount of impurity that may be added should not exceed ·02 per cent. Now an average adult breathing quietly gives off ·6 cubic foot per hour, and therefore if this

adult were confined for an hour in a room of 3,000 cubic feet capacity, into which no air could penetrate from outside, the air of the room at the end of the hour would contain the limit of ·06 per cent. of carbonic acid. But, of course, in an ordinary room a good deal of air would enter during an hour, and what we want to know is, how much ought to enter? It has been found that in this country it is impracticable with the ordinary means of ventilation (without warming the incoming air) completely to renew the air of a room more than three times during an hour without producing draughts. From this it is easy to see that the amount of cubic space in a room should not be less than 1,000 cubic feet per adult. It need hardly be said that this standard of cubic space is not often attained. Nevertheless, it is the standard at which we should aim.

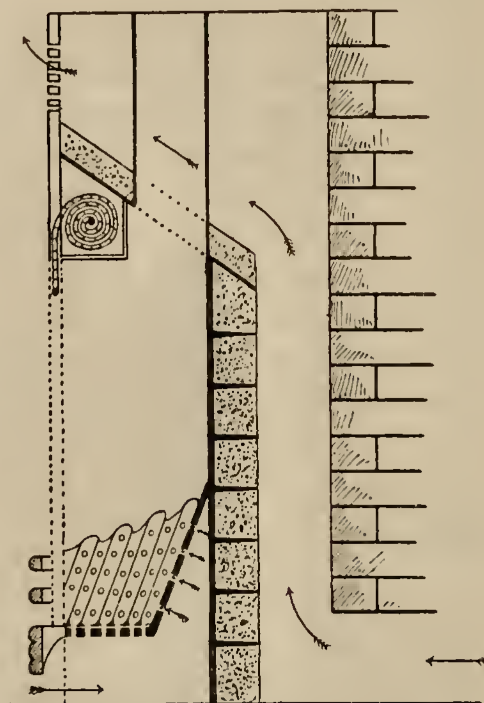

Fig. 126.—Galton Grate.

Ventilating Openings.

The difficulties of ventilation are lessened if the incoming air is warmed, for warm air is not felt as a draught, and it is possible therefore to change the air of a room more frequently than three times an hour. One method of warming the incoming air has already been described in the hall ventilating stove. Another method is afforded by the grate which was originally designed by the late Sir Douglas Galton for use in barrack rooms, and which is generally known as the "Galton grate" (Fig. 126). This grate is thus described by its inventor:—

"Fresh air is admitted to a chamber formed at the back of the grate, when it is moderately warmed by a large heating surface and then conveyed by a flue adjacent to the chimney flue to the upper part of the room, where it flows into the currents which already exist in the room. The effectual combustion of the coal is obtained by limiting, to a certain extent, the draught at the bottom of the grate and supplying warmed air to the top of the fuel at the back of the grate."

If a Galton grate is used, the air chamber should be lined with fire-clay or wrought iron, and facilities should be afforded for cleansing the chamber.

It should be borne in mind that the more carefully and well a house is built the fewer chinks and crannies will there be for air to enter, and the more important, therefore, will it be to provide a sufficient number of ventilating openings. These are of two kinds—inlets and outlets; and two of the former have already been described in the ventilating stove and the Galton grate. Windows are valuable inlets if they are open, as they should usually be, but in winter an open window with a bright fire may cause discomfort unless some method be adopted to avoid draught. The Hinckes-Bird ventilator is one of these.

Hinckes-Bird Ventilator.

A piece of wood about 4 inches deep, and extending the whole width of the window, is fixed to the lower sill beneath the sash so that the latter may be raised 4 inches, and so admit an upward current of air between the two sashes. The same result may be secured by constructing a deep bottom bead inside the window frame. *Perforated bricks* are useful ventilators. The holes are conical in shape, with the narrow ends outside, so that the current of incoming air slackens as it traverses the wall and enters the room without causing draughts. *Sherringham's valve* is a small vertical flap which, being hinged below, falls forward towards the room, and thus the air enters in an upward direction. *Tobin's ventilator* is a large vertical tube, rising at least 5 feet from the floor, having one opening at the bottom to admit air from outside, and another at the top to discharge the air upwards into the room. The position of the inlets requires consideration. The air must be introduced in such a way as to avoid draught and to secure that the fresh air is well diffused throughout the room. If the air is warmed, it is desirable to place the inlets near the floor; if the air is cold it should enter above the heads of the occupants and in an upward direction. Hot air ascends, cold air descends;

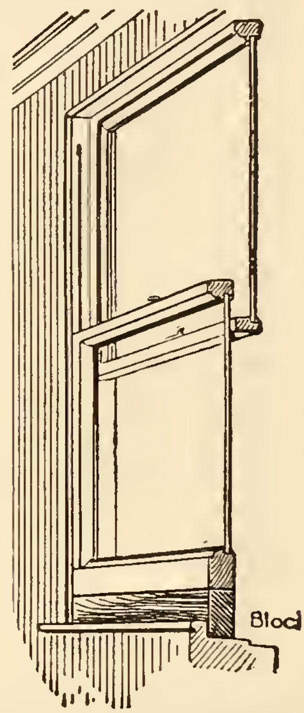

Fig. 127.—Method of Window Ventilation.

these are the points to bear in mind in arranging the position of ventilators.

The usual outlet in a dwelling-room is the chimney flue, and when a fire is burning in the grate it is a powerful extractor. A chimney flue with an ordinary fire extracts from 10,000 to 15,000 cubic feet of air per hour, the current being from 3 to 6 feet per second. With a large fire the current of air drawn up the chimney may have a velocity of 8 or 9 feet per second. Even without a fire a chimney flue

Outlets.

Fig. 128.—Tobin's Tube.

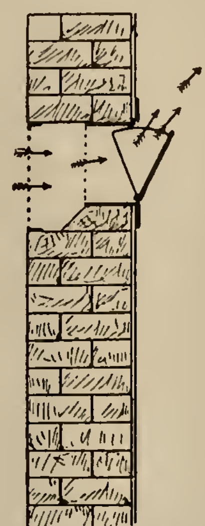

Fig. 129—Sherringham's Valve.

is a valuable extractor of foul air, and it should never be stopped up by closing the register or by any other means. This precaution is often neglected, and the closed register has contributed not a little to the spread of consumption and other disease.

The ordinary grate is not well placed as a ventilator. Foul air, being warm, rises to the top of the room, and the best position for an outlet is in or near the ceiling. It is desirable, therefore, to provide outlets in addition to the fireplace. Arnott's or Boyle's valves may be used. These are small talc plates which open into the chimney flue near the ceiling. They are so hung that they permit air to enter the flue, but prevent its return. Unfortunately, however, they are liable to get out of order, and may allow smoke to enter the room from the flue. A better plan is to construct a shaft surrounding the chimney flue with inlets opening into the shaft near the ceiling, and an outlet at the level of the chimney top. The air ascending this shaft will be kept warm

by the heat of the chimney, and will maintain its tendency to ascend, and the reflux of smoke down the shaft will be avoided.

Gas jets may be employed as extractors of foul air. The combustion of one cubic foot of coal gas will extract 1,000 cubic feet of air. An extraction shaft placed over a gas lamp or chandelier forms a very useful ventilator.

LIGHTING

Light has a most important influence upon health. It is essential to a healthy life. Absence of light causes depression, mental and physical, and it is particularly harmful to young growing organisms. There is an old saying that "where the sun never enters the doctor always does." The prevailing superstition that a dark room is a good thing for an invalid is much to be deplored. It is now known that a well-lighted room is a powerful factor in recovery from disease. Miss Florence Nightingale, in her "Notes on Nursing," attaches the greatest importance to light, and she points out that invalids turn in bed towards the light. In 1866 Sir David Brewster made some observations on the influence of sunlight on cholera during the epidemic in Edinburgh in that year, and he found that the mortality on the shaded side of the narrow streets was distinctly higher than on the sunny side. Light is a powerful disinfectant. Exposure to sunlight will soon cause the death of virulent microbes such as the organisms of anthrax, typhoid fever, and tuberculosis. So important is the influence of light upon health that the invention of glass must be regarded as a hygienic event of the first magnitude; and it is most probable that the free use of glass in modern building construction has contributed in no small degree to the diminished mortality of the present time.

The first requisite in the efficient lighting of a house is sufficient open space outside the house. This is a matter that was formerly much neglected, but is now to some extent provided for by building bye-laws prescribing a minimum width for streets and backyards. Assuming that an adequate open space exists outside the house, the next question is how to get sufficient light into the house. The first essential is to light the passages and staircase, but this is a consideration that never troubles the mind of the jerry-builder. Dr. Poore thus vividly describes the dark staircase that is found in too many British houses :—

"Starting from the front passage, the only light of which is from a closed fanlight over the door, the staircase oscillates between water-closet doors

and bedroom doors, getting darker and darker as it ascends. In the houses of artisans, every doctor must be familiar with the rancid whiff that comes up the absolutely dark stairs leading to the basement : the cold, damp smell of mildew and soot in the sacred front parlour, where the 'register' is closed and the blinds are drawn ; and the variety of odours which assault his nose until he arrives at the carbolic sheet protecting the door of the room containing the case of infectious illness he has possibly come to see."

For lighting the staircase and passages a fanlight made to open should be provided over the front door, and another at the top of the staircase. These represent the minimum requirements ; other lights should be provided where possible.

Turning to the rooms, we have now to ascertain what amount of window space is needed. The model bye-laws of the Local Government Board require the total window area, clear of the sash frame, to be equal to at least one-tenth of the floor area ; but this is a minimum requirement. In practice it is better to be more generous in the allowance of window space. The bottom window pane should not be placed so high that it cannot conveniently be seen through by a person in the sitting posture, but the top of the window should be as near the ceiling as possible. This is desirable not only for ventilation (every window, of course, should open at the top), but also because it enables the light to be projected furthest into the room. The rays of light reaching the part of the floor furthest from the window should have an incidence of not less than 30 degrees, and this involves that the depth of a room should not exceed one and a half times the height from the floor to the top of the window.

ARTIFICIAL LIGHTING

The chief agents used for artificial lighting are (1) candles, (2) oil lamps, (3) coal gas, (4) electricity.

Candles are expensive, wasteful—for they give off a large amount of unconsumed carbon—and inconvenient, and they are now little used.

Oil lamps are of two kinds, kerosene lamps and colza oil lamps. Kerosene, which is much cheaper than colza oil, is obtained by the distillation of crude petroleum, and it gives off an inflammable vapour which takes fire at a temperature varying with different qualities of the oil. This temperature is called the "flash point." The dangers of low flash oil were investigated some years ago by a Parliamentary Committee, who recommended that the flash-point

Oil Lamps.

should not fall below 100° F., and that the manufacture of lamps should be regulated by law.

If lamps are used for lighting the house they should be well made. Cheap lamps are not unlikely to prove the dearest in the long run. Lamps should be strongly made. Both reservoir and burner should be strong ; the burner should screw firmly into the collar, and the base of the lamp should be broad and heavy so that it is not likely to be upset. A lamp should have a proper extinguisher and so obviate the need for blowing down the chimney, which should never be done. Lamps should be carefully trimmed and kept scrupulously clean.

Colza oil is much safer than kerosene, as it does not give off inflammable vapour, but its illuminating power is less, the lamps require more care in trimming, and colza is about three times as expensive as kerosene.

Gas

Coal gas contains several illuminants, the chief being olefiant gas, C_2H_4. Lighting by coal gas is cleaner and much more convenient than lighting by lamps. Gas, however, has disadvantages. There is the danger of gas leakage, already referred to. In combustion gas gives off sulphurous acid, which is injurious to health and destructive to furniture. Gas dries the air unduly, and unless the supply of gas is carefully regulated during combustion some of the carbon will be unconsumed and deposited as soot in the room.

If gas is used the following precautions should be observed :—

1. The meter should be a "dry meter."

2. A small pipe, fitted with a cock, should be carried down from the lowest part of the domestic service. This will enable any accumulation of water to be drawn off.

3. All fittings should be tested before being fixed.

4. The burners should be carefully selected. The incandescent burner is much the best, and is also the cheapest to use.

5. The pressure should be regulated by "governors."

6. The burner, when possible, should be ventilated.

Electric Light.

In the incandescent lamp, which is generally used for domestic electric lighting, the current is passed through a coil of filamentous carbon enclosed in a glass bulb which is either exhausted of air or filled with some incombustible gas, such as nitrogen. The carbon resists the passage of the electric current and in the struggle is raised to a white heat.

Electric lighting, from a health point of view, is much the best. It consumes no oxygen, it gives off no products of combustion to foul the air, and it produces very little heat. It has been asserted that it has an injurious effect on eyesight, but no satisfactory evidence of this has yet been forthcoming.

WATER SUPPLY

A water supply of some kind or other is one of the prime necessities of human existence. Without water life cannot be maintained, and the more mankind advances in civilisation the more exigent becomes the demand for water. The quantity demanded continually tends to increase, and with the growth of our knowledge of water-borne disease there comes an increasing caution as to the quality of the water we use. A sufficient supply of suitable water must be regarded as one of the first essentials of a healthy home.

Quantity Needed.

What is a sufficient supply? According to Dr. Parkes, a middle-class household requires 6 gallons per head for domestic washing and cooking, 5 gallons for ablution, including a sponge bath, 6 gallons for water-closets, 4 gallons for general baths, and 3 gallons for unavoidable waste. In addition, it is generally estimated that from 5 to 10 gallons per head per day are required for street watering and other municipal purposes, and a similar quantity for trade processes. The total daily supply of water in a modern town should, therefore, be about 40 gallons per head. The quantity generally supplied in this country is about 30 gallons. In London and Manchester it is 32 gallons. In the matter of water supply we are far behind Imperial Rome. At the end of the first century Rome rejoiced in a water supply which has been estimated as equivalent to no less than 230 gallons per day for each inhabitant.

A Suitable Water.

Water may be unsuitable from various causes. It may be too "hard." "Hardness" is due to the presence in solution of certain chemical compounds that decompose soap, and so entail a considerable loss of soap before a lather can be obtained. Hardness may be *temporary* or *permanent*, according to the nature of the soap-destroying matter it contains. If this consists of carbonates, the water possesses temporary hardness. Carbonates are held in solution because of the presence of carbonic acid in the water, and if the water is boiled the carbonic acid is driven off, carbonates are deposited, and the water becomes soft.

Permanent hardness is due to the presence of soap-destroying compounds in the form of sulphates which are not removed by boiling the water. Hard waters are objectionable. They deposit a crust or "fur" on the inner surface of boilers, which causes loss of heat and sometimes explosions. They give rise to a considerable waste of soap. It has been estimated that each degree of hardness * involves a waste of nearly 1 lb. of soap for every 1,000 gallons of water used in washing. Moreover, hard waters—especially those possessing permanent hardness—may give rise in susceptible persons to indigestion and diarrhœa.

Soft Water.

It has been said that the lime salts in hard waters prevent rickets, and that rickets is unusually prevalent in towns with soft water. No satisfactory evidence, however, has been brought forward to support this view. Rickets is exceedingly common in London, where the water is distinctly hard. A more serious objection to soft water derived from moorland gathering grounds is that it is capable of dissolving lead from leaden service pipes and cisterns. Many cases of lead poisoning, chiefly in Sheffield and other Yorkshire towns supplied with moorland water, have been attributed to this cause, but the danger may be averted by proper precautions.

Water-borne Diseases.

From the public health point of view, the chemical properties of water are of secondary importance. The thing that most matters about water is its capacity for conveying the living organisms of disease. Dysentery, diarrhœa, and various kinds of intestinal worms may be transmitted by polluted water, but the chief water-borne diseases are cholera and typhoid fever, as we have seen in an earlier chapter.

Prevention of Pollution

Water may be polluted at the source of supply, in transit, and in the home of the consumer. In the vast majority of cases the consumer has no control over the two first channels of pollution. Most of us have water "laid on" and are obliged to take what the local company or corporation supplies. Fortunately most public supplies are well looked after; in no department of sanitation has greater progress been made than in the supply of water. If, however, there is any reasonable fear of water-borne disease the water should be boiled. This will effectually destroy all disease-producing organisms.

* A degree of hardness is equivalent to one grain of calcium carbonate per gallon of water.

A great deal of money has been wasted by householders in the purchase of filters. Most filters are worse than useless for keeping back germs; they merely act as storing-places where germs accumulate. The present writer knows of only two filters that sterilise water—*i.e.* free it from germs. These are the Pasteur-Chamberland and the Berkefeld. The former consists of a hollow cylinder of unglazed porcelain, and the water in passing through the wall of the cylinder gives up any germs it contains, the pores of the porcelain being too fine to allow them to penetrate. The Berkefeld is similar in principle, but the hollow cylinder is composed of a diatomaceous earth called *Kieselguhr*. It is a mistake to imagine that either of these filters can be installed and then left to work automatically for an indefinite period. Both the Pasteur-Chamberland and Berkefeld filters require frequent cleansing if they are to retain their efficiency.

Filters.

RURAL WATER SUPPLIES

Many dwellers in the country have no access to a public water supply, and each householder has to provide his own water. The sources open to him are rain water, springs, and wells.

Rain Water.

Rain water cannot be depended upon as a sole source of supply, but being soft it is useful for washing, and may be worth collecting. The rain that first falls on the roof is so dirty as to be useless, but there is a convenient appliance that separates and ejects the first washings. Even then, however, it is advisable to pass the water into a settling tank and finally through a strainer of gravel and sand.

Springs and Wells.

Springs generally yield a pure supply, but they are seldom available, and practically, where water cannot be "laid on," recourse must be had to wells. Wells are of two chief kinds—*shallow* and *deep*. It is sometimes said that a shallow well is one that is less than 50 feet deep, but it is better to define it as a well that is sunk in a superficial bed of sand, gravel, etc., overlying an impermeable stratum. Shallow wells are common but undesirable sources of rural water supply. They are much exposed to pollution, not only from surface washings, etc., but also from leaking drains and cesspools. Cesspools are rarely made watertight, and their contents soak away into the adjoining earth, and into the nearest wells. If a shallow well must be used it should be as far as possible from the

cesspool and at a higher level, and the walls of the well should be lined with impervious material. The wall should be raised above the surface of the surrounding ground, which should be covered with concrete near the well. The top should be covered and the water raised by a pump.

It is curious to note that water from a polluted well is often sparkling and palatable. This is due to the carbonic acid it contains. It will be found, however, that if such water be kept in a bottle in a warm place it soon becomes turbid and offensive. Well water should not be used unless it has been analysed and reported upon by a competent analyst.

Where water is "laid on" there should always be a tap from the main, and no other should be used for drinking purposes. It is convenient for storage to provide a cistern, which should be put in a cool place, preferably on the north side of the house, provided with a good cover, and carefully cleaned out about once in three months. This involves, of course, that the cistern must be placed in an accessible position—a consideration that is frequently disregarded by builders.

Cisterns.

REMOVAL OF REFUSE

Human life necessarily involves the formation of a considerable amount of waste matter, and the first principle of sanitation is that this waste matter shall be promptly removed from the vicinity of human habitations and so dealt with that it becomes innocuous. This is almost a self-evident proposition, but its practical application is still very much neglected. Waste matter may be divided in two classes:—(1) *dry refuse* and (2) *wet refuse,* which includes excreta, waste water, and surface washings.

Dry refuse consists of fire waste (cinder and ashes), food waste (potato peelings, leaves, etc.), and general household rubbish. In some rural districts the householder has to dispose of all this matter as best he can, but in most districts the periodical removal of dry refuse is undertaken by the sanitary authority.

Dry Refuse.

Food scraps should never be put into the dustbin. Such matter tends rapidly to putrefy, especially in the summer. In many cases the dustbin has perforce to be placed near the kitchen, and it is only in exceptional cases that it is emptied more frequently than once a week. If food waste is put into the dustbin there will always be an

accumulation of foul, decomposing matter near one of the most important parts of the house. Food waste should be burned in the kitchen fire. This precaution, however, is becoming more rarely observed, for with the increasing use—especially in summer—of gas stoves for cooking, the kitchen fire is often not lighted at all during the day. Hence it becomes increasingly important to observe other precautions.

Dustbins. The old-fashioned brick ashpit is still too often used for the storage of house refuse. Sometimes it is placed below the level of the ground, and the cover is frequently missing, thus allowing rain to enter and hasten putrefaction. The way these ashpits are emptied is by shovelling up the contents into the scavengers' baskets, which are then emptied into the dustcart. In the shovelling process a good deal of dust is raised, especially if a wind is blowing, and the whole process is most disagreeable. Moreover, the sides of the pit become foul and the contents are seldom entirely removed. If the householder has an ashpit of this kind on his premises, he should immediately take steps to get rid of it, and to provide a movable dustbin of metal with a proper cover. The metal bins are carried bodily to the dust-carts and then emptied. They get a good deal banged about in the process, and need to be replaced more often than would be necessary if they were more carefully treated by the scavengers. Dustbins should be scraped out occasionally and thoroughly cleansed. In some districts the scavengers put a little bad-smelling powder in the dustbin to "disinfect" it, but there is no real disinfectant effect in such powder, and it only makes more dust to clean out of the dustbin.

DRAINAGE

In districts where the "water-carriage" system is in use the house drains serve to carry off (1) surface water, (2) rain water from the roofs, (3) waste water from sinks, lavatory basins and bath, (4) excreta, and in some houses (5) ground water. The method of draining the latter has been referred to in describing the ground water, and it is not necessary to say more about it.

The house drains may discharge into a sewer or a cesspool, but the methods of construction are the same in each case. The first thing to be borne in mind in planning a drainage system is that the house drain must be separated or intercepted from the sewer (or cesspool) in such a way that sewer gases shall be kept out of the drain. This is done

by fixing near the boundary of the premises a proper intercepting trap.

A trap is a contrivance for preventing the escape of gases from drains. Traps are of various kinds.

Traps.

Fig. 130 shows the ordinary form of trap for a house drain. The shaded portion is the water that prevents the sewer gas from passing into the drain. The part of the water which forms the seal of the trap should not be less than $2\frac{1}{2}$ or 3 inches in depth.

Traps play an important part in drainage systems, and it may be useful to state the characters of a good trap. These are (1) the capacity to cleanse itself, (2) freedom from liability to get out of order, (3) capacity to maintain an efficient seal with a minimum amount of water. To fulfil these conditions a trap should be free from mechanical appliances, of uniform bore, and as small as possible. The inlet arm of the trap should be vertical, and there should be a clear drop of 3 inches from the invert of the drain to the surface water in the trap, so that a small cascade may be formed to drive out completely the contents of the trap.

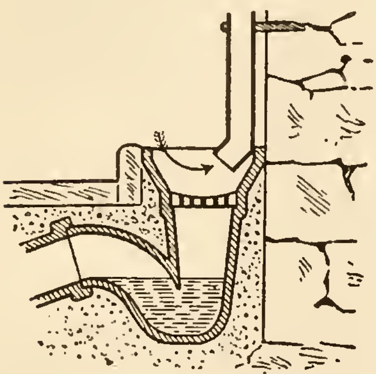

Fig. 130.—Ordinary Form of Trap for House Drain.

The intercepting trap between sewer and drain should be provided with means of access, so that any stoppage may be removed. The form of access is a manhole, such as is shown in Fig. 131. The floor of the manhole rests on concrete, the sides are formed of bricks lined with cement, and there should be a properly fitted metal cover. The manhole should be watertight. Above the trap there is a raking arm, A, through which rods may be introduced to remove any obstruction in the drain on the sewer side of the interceptor. At B there should be a tightly fitting cap to prevent sewer gas from entering through the raking arm.

Starting from the front manhole we may now proceed to trace the house drain backwards. There are several points to be observed in the construction of a drain, which may be stated as follows :—

1. The drain should not run under the house. This will prevent drain gas from entering the house should the drain become defective.

2. The drain should as far as possible be laid in a straight line. Where a bend is necessary a manhole should be provided.

3. The drain should have a uniform bore, and a sufficient and uniform fall. The fall required varies with the internal diameter of the drain. With a diameter of 4 inches (the usual diameter of a house drain) the

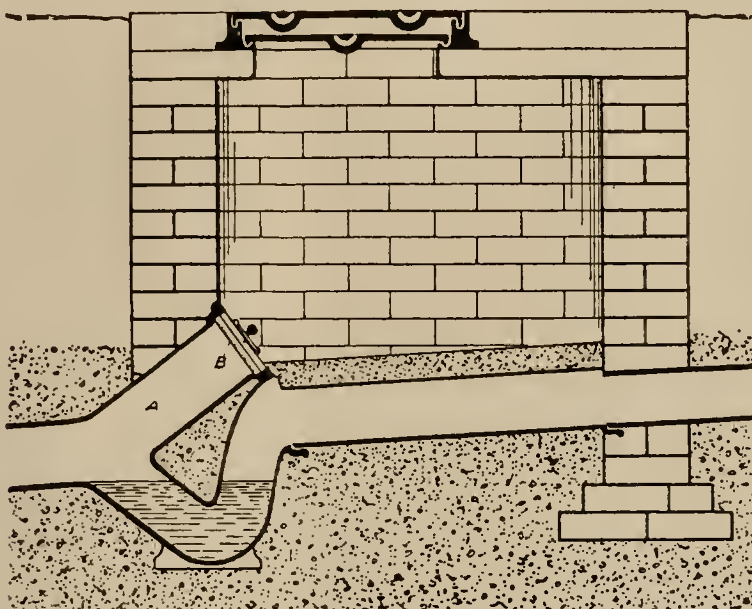

Fig. 131.—Inspection Chamber for Trap Between Sewer and Drain. A, "Raking arm," closed by a cap, B.

fall should not be less than 1 in 40, with a 6-inch drain it should be 1 in 60, and with a 9-inch drain not less than 1 in 90.

4. The drain must be laid on a bed of concrete not less than 6 inches thick, which should project on each side of the drain for a distance which should be not less than the external diameter of the drain.

5. The drain should consist of sound material, should be well jointed and watertight. Most drains are constructed of glazed stoneware pipes 2 feet in length. The joints should be socket joints, properly put together with cement. Cast-iron drains are now being much used. They are more durable than stoneware, and as they are made in 9-feet lengths they require fewer joints. Iron drains are rather more expensive than stoneware, but being more durable they are probably cheaper in the long run. Every part of the drain should be watertight to the extent that it can resist a pressure of at least 2-feet head of water.

6. The drain should be freely ventilated. The usual plan is to fix

an inlet near the ground level and as near the interceptor as possible. and an outlet well above the roof at the other end of the drain. The wind blowing across the top of the outlet pipe sucks up air through the pipe, through the drain, and through the inlet. Usually the soil pipe acts as the outlet of the drain.

If a drain is constructed of good material, well laid, with a good fall, and properly ventilated, it ought not to be offensive or to give off foul gases. Such a drain should be self-cleansing, and if stoppage occurs it can only be the result of gross carelessness. But drains are frequently subject to very bad treatment. All kinds of curious objects—brushes, boots, lumps of coal, etc.—have been found in the intercepting trap, giving rise of course to stoppage. A drain must not be used as a dustbin.

We may now consider what properly goes into the drain, viz. surface water, rain water, waste water and excreta; ground water has already been dealt with. First, it is important to bear in mind that all openings to the drain, except those expressly provided as ventilating openings, must be trapped—*i.e.* provided with a water seal to prevent the egress of drain air. The soil pipe, which is untrapped, is not an exception to the rule, because it is really also a ventilating pipe.

The amount of surface water entering the drain may be considerable in heavy rain, especially if the ground immediately in contact with the house is paved, as it should be. Surface water must enter the drain through a gully provided with a proper trap, with a water seal of not less than 2½ inches. Fig. 132 shows a good type of gully trap. In dry weather there is a tendency for gullies to become unsealed by the evaporation of the water in the trap, and it is advisable to make baths, sinks, and lavatory basins discharge over the gullies, taking surface water in order to keep them sufficiently charged. A gully should be covered with a grating to keep out stones, dead leaves, etc., that might tend to choke the drain.

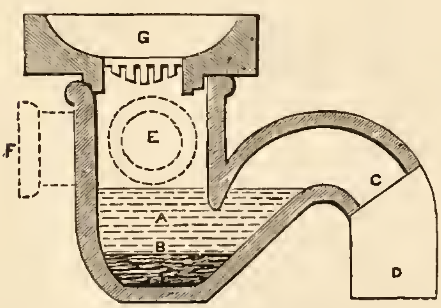

Fig. 132.—Yard Gully.

Rain water from the roof is collected in open iron gutters, which discharge into rain-water pipes. It is important that the gutters should

be carefully fixed to prevent rain water from trickling down the wall, and so producing dampness. Gutters tend to get choked with dead leaves, etc., and then the water overflows and runs down the wall. The gutter should therefore be cleaned out from time to time.

Roof Water.

RAIN-WATER PIPES

Rain-water pipes should convey rain water and nothing else. Excreta and the waste water from sinks, lavatories, and baths should never enter a rain-water pipe. If this precaution be not observed the pipes, which are too large in diameter to be self-cleansing, will become encrusted with decomposing filth, and will give off foul gases, which will be drawn into the house.

A rain-water pipe should discharge over a trapped gully. It may discharge under the grating of the gully, but the end of the pipe must be well above the water in the trap so that fresh air can circulate right through the pipe. A rain-water pipe should not be used as a drain ventilator. Its upper end is not placed where a ventilating opening should be placed. The upper opening of a ventilating pipe must be carried well above the roof, which is impossible for a rain-water pipe; and another objection is that in times of storm, when free ventilation of the drain is most needed, the rain-water pipes are full of rain and useless as ventilators.

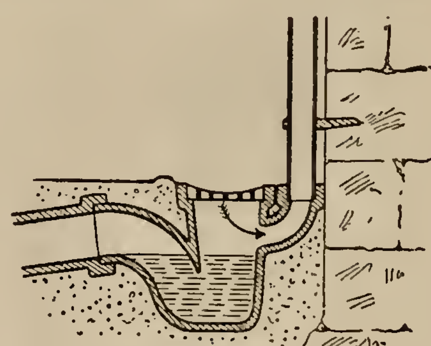

Fig. 133.—TRAPPED GULLY FOR RAIN-WATER PIPE.

WASTE PIPES

The pipes taking waste water from sinks, baths, and lavatory basins should be made of lead, and as it is important that they should be self-cleansing, they should be as small as is consistent with efficiency. The most suitable diameters are as follow :—

For baths	$1\frac{1}{2}$ in. to 2 in.
For pantry and draw-off sink ..	$1\frac{1}{2}$ in.
For scullery sink	$1\frac{1}{2}$ in. to 2 in.
For lavatories	$1\frac{1}{4}$ in. to $1\frac{1}{2}$ in.

Each sink, etc., must have immediately under its outlet an efficient trap, which should be provided at the lowest point on the trap with a

screw-tap to give access for cleansing. The object of the trap is to prevent the air from the waste pipe, which may be offensive, from entering the house. Fig. 134 shows a good waste-pipe trap.

The trap should be ventilated ; first, because an unventilated trap may become unsealed through syphonage, and second, because it is important that a free current of air should circulate through the pipe

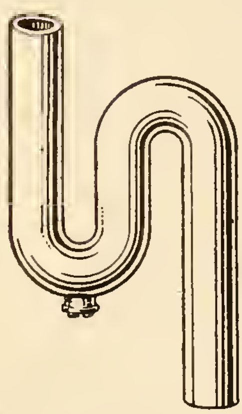

Fig. 134.—Waste-pipe Trap.

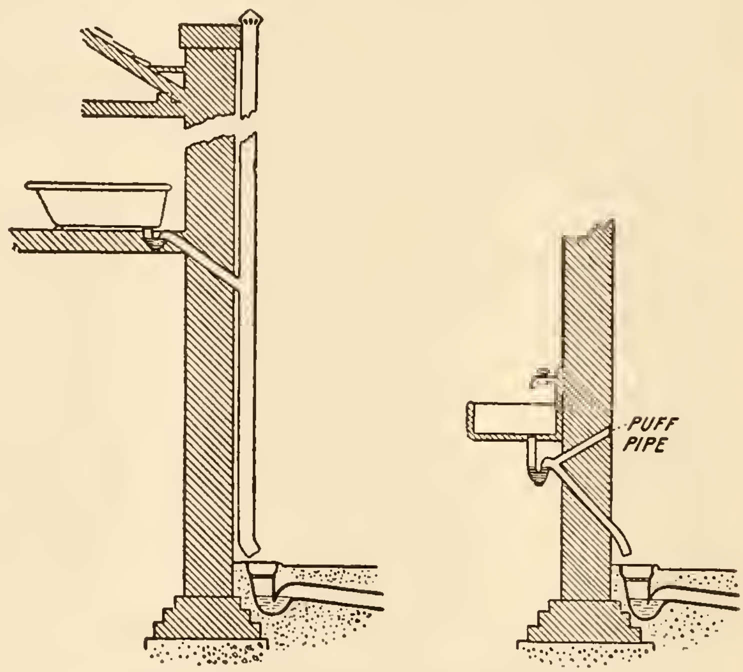

Fig. 135.—Ventilators for Waste Pipe.

to keep it free from offensive gases. The ventilator may be provided by a puff pipe (as shown in Fig. 135), but in many cases it will be preferable to carry the waste pipe up the wall and above the roof. An objectionable method is to make the pipe discharge into a hopper head. The head becomes coated with decomposing soap and grease, and unless very carefully attended to will give rise to nuisance.

Every waste pipe should discharge in the open air over a gully, and it is preferable to carry the pipe below the gully grating as shown in Fig. 133.

WATER-CLOSETS

A water-closet apartment should be approached from the open air or from a cross ventilated lobby. In many cases, however, neither

of these arrangements is practicable, but at all events the apartment should always have at least one external wall, in which there should be a window large enough to light the whole of the apartment. The window should be made to open, and in addition to the window there should be an air-brick or other means of permanent ventilation. The walls of the apartment should be so constructed as to prevent the passage of air, the apartment should not open into a room, and outside there should be an open area of not less than 100 square feet.

Water-closet Apartments.

Water-closets may be divided into two main classes, according to whether they have or have not a movable apparatus for retaining water in the basin. There are good and bad types in both classes. We may first consider the essentials of a good water-closet.

Water-closet Apparatus.

1. Every water-closet should be provided with a separate cistern, which must only be used for flushing the closet and for nothing else. Formerly it was a common practice to flush closets from a drinking-water cistern—a practice which has caused numerous cases of typhoid fever, one of the best known outbreaks of this kind occurring at Caius College, Cambridge, in the pre-sanitary era.

2. The cistern should have a capacity of not less than two gallons. Three gallons is very much better, and for valve closets a capacity of about six gallons is required.

3. The cistern should be placed at least 4 feet above the rim of the closet, and the flushing pipe connecting the cistern to the closet basin should be not less than $1\frac{1}{4}$ inches in diameter throughout. These requirements are necessary to secure an effective flush.

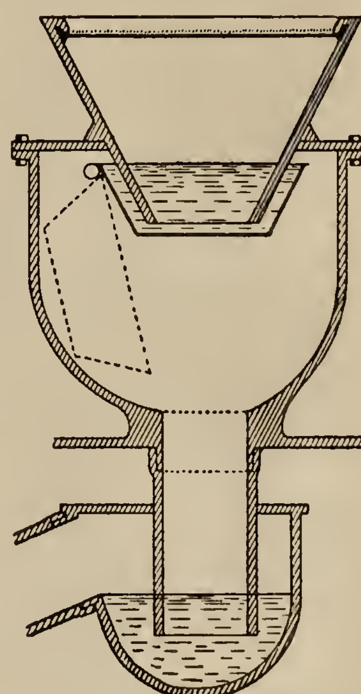

Fig. 136.—The Old Pan Closet.

4. The closet basin should have a "flushing rim" to deliver the water all round the basin and so wash it clean. In the old long hopper closet there is a side inlet for the water, which issues in a thin stream and winds in a spiral direction down the basin, doing practically nothing in the way of flushing.

5. The back of the basin should be vertical. This allows the excreta to fall clear of the basin.

6. The basin should always contain sufficient water to immerse the solid excreta.

7. There should be no container under the basin. The old "pan" closet (*see* Fig. 136) had a large container which soon became unspeakably foul.

8. The closet must have an efficient syphon trap with a water seal of not less than $2\frac{1}{2}$ inches.

The worst of all the bad forms of water-closet is the *pan closet*, which formerly enjoyed an enormous popularity, and was found in all kinds of houses, from the most aristocratic of mansions to the lowly dwellings of the poor. It would hardly be possible to devise a more insanitary apparatus. The basin consists of china (usually of a highly pictorial kind), and is shaped like an inverted cone, and consequently becomes fouled with excreta. Water is retained in the basin by a large movable pan, which, when the handle is raised, swings back into a large container. Every time this happens the container is splashed, and it soon becomes coated with filth. From the container a short pipe leads to the trap, which is usually a D trap. This trap soon becomes as foul as the container, and both act as generators of disgusting gases. It has been well said that the D trap has been appropriately named, for it collects dirt and causes disease and death. The "pan" closet in the days of its popularity had the further disadvantage that it was generally supplied with water from the cistern supplying the house with drinking water.

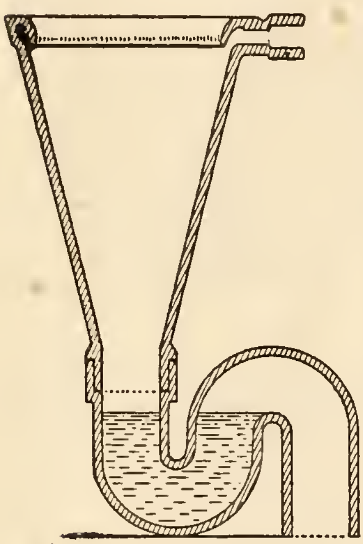

Fig. 137.—Long Hopper Closet.

The *long hopper closet* (Fig. 137) is another survival of the pre-sanitary era. It is so shaped that it is bound to get foul, and, as

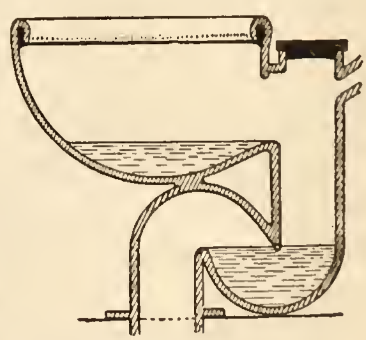

Fig. 138.—Wash-out Closet.

we have said, the spiral flush with which it is usually provided is useless for cleansing the basin.

The "*wash-out*" (Fig. 138) is a bad form of closet. The water in the basin is insufficient to immerse the excreta; when the basin is flushed the contents are thrown against the front of the closet, which becomes foul; and the flush is broken by the trap, which therefore retains some of the excreta.

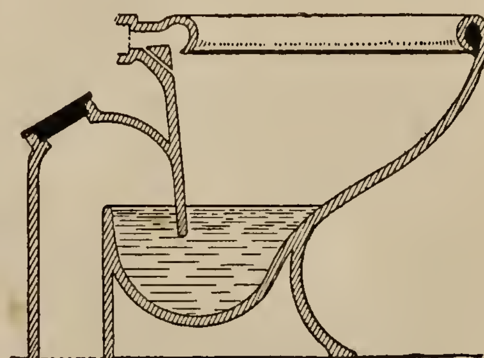

Fig. 139.—"Wash-down" Closet.

The "plunger" is also to be avoided. It soon becomes foul, the plunger gets coated with filth, and then becomes incapable of retaining the water.

The best form of water-closet is the "*wash-down*" (Fig. 139). It is simple in construction, self-cleansing, and effective. Its disadvantage is that it is noisy in use, from the rush of water, but from a health point of view it has no rival.

The "*valve*" *closet* (Fig. 140) is much quieter in action than the "wash-down," but it requires much more water for flushing, and in other respects is not so satisfactory.

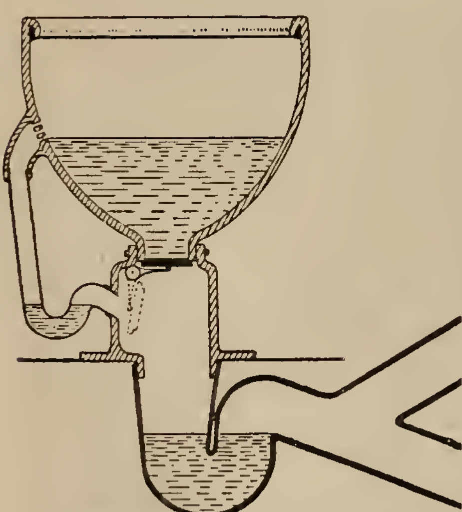

Fig. 140.—Valve Closet.

If there are any water-closets on the upper floors it will be necessary to provide a "soil pipe," which is practically a continuation of the drain in a vertical direction, and should not therefore be trapped. The soil pipe may be constructed of lead or iron; it should be not less than $3\frac{1}{2}$ inches in diameter, and it should be continued upwards with as few bends as possible, until it ends well above the roof and well away from all windows, chimneys, or other openings.

When more than one water-closet is connected to a soil pipe there is a danger that when one of the upper closets is flushed the contents in descending the pipe may syphon out the water in the traps of the lower closets. This can be effectually guarded against by ventilating

the trap of each of the closets, at the side nearest the soil pipe, by an anti-syphonage pipe, which should not be less than 2 inches in diameter, and should either be continued up as high as the soil pipe, or open into the soil pipe above the level of the highest water-closet.

KEEPING THE HOUSE CLEAN

We have now indicated the chief points in the structure of a healthy home, and it remains to say a few words about keeping it clean. Cleanliness, however, depends considerably upon structure. Most houses are so full of dust traps in the form of projections, mouldings, cornices, etc., that they are not easy to keep clean. There should be as few as possible of these in a healthy home. It would, for instance, be a great reform if skirtings could be abolished and the smooth plastered walls continued and rounded off to meet the floor. This alone would very considerably facilitate cleansing. Ample window space assists in keeping the house clean, for windows let in the light to show up the dust in the house. Windows should be obstructed as little as possible with blinds and curtains. Venetian blinds are especially to be avoided. It is pitiable to think of the enormous amount of human effort that has been put forth in the vain endeavour to keep Venetian blinds free from dust.

Heavy furniture, especially in bedrooms, obstructs cleansing. Furniture should be light, so that it can be easily moved and the floor beneath cleansed. Carpets are perhaps the most insanitary things in a house. The amount of refuse that a carpet can harbour can only be appreciated by those who have watched the operations of a vacuum cleansing machine. It is infinitely better to abolish carpets and, if parquetry is considered too expensive, to stain the floors and lay a few rugs or pieces of Indian matting where some floor covering is required. It is especially important that the bedrooms should be kept clean. The furniture should be reduced to a minimum. Bed curtains and valances should be ruthlessly abolished. From a health point of view there is nothing to be said for bedroom slops. Washing should be done in bath-rooms, and with the ample water-closet accommodation that is found in modern houses there is no excuse for using the bedroom as a urinal. The practice of sleeping all night with a collection of urine within a few feet of the bed is contrary to the first principles of sanitation.

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